



**CITY OF NEWARK**  
**DELAWARE**

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Bid Security

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Vendor

CITY OF NEWARK

Delaware

CONTRACT NO. 18-04

CORRUGATED METAL PIPE (CMP) LINING - 2018

NOTICE

Return intact with properly  
completed forms or bid may be rejected.

CITY OF NEWARK

Delaware

CONTRACT NO. 18-04

CORRUGATED METAL PIPE (CMP) LINING - 2018

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CITY OF NEWARK

Delaware

CONTRACT NO. 18-04

CORRUGATED METAL PIPE (CMP) LINING - 2018

NOTICE OF LETTING

Sealed bids for Contract No. 18-04, "CORRUGATED METAL PIPE (CMP) LINING - 2018", will be received in the Purchasing Office, Newark Municipal Building, 220 South Main Street, Newark, Delaware 19711 until 2:00 p.m., prevailing time, June 26, 2018 and will be publicly opened and read aloud in the Council Chamber shortly thereafter.

A non-mandatory pre-bid meeting will be held on June 6, 2018, at 10:00 a.m. at the Newark Municipal Building. Site visits are allowable and must be scheduled at least 10 days in advance of bid submission. For information, call (302) 366-7000.

Plans and Specifications may be obtained from the City's web page [www.cityofnewarkde.us/bids.apsx](http://www.cityofnewarkde.us/bids.apsx). Information can be found by accessing the Bid/Proposal Opportunities link on the home page.

CITY OF NEWARK

Delaware

CONTRACT NO. 18-04

CORRUGATED METAL PIPE (CMP) LINING - 2018

GENERAL PROVISIONS

**1. BIDS**

Each bid shall be submitted on the proposal form included herein. The proposal and all other required documents must be submitted in a sealed envelope clearly identified with the bidder's name and marked "City of Newark - Contract No. 18-04, "CORRUGATED METAL PIPE (CMP) LINING - 2018." Bid Documents must be received in the Purchasing Office prior to 2:00 p.m. prevailing time, June 26, 2018. Each bid so submitted shall constitute an irrevocable offer for a period of sixty (60) calendar days following the bid opening date.

A non-mandatory pre-bid meeting will be held on June 6, 2018, at 10:00 a.m. at the Newark Municipal Building. Site visits are allowable and must be scheduled at least 10 days in advance of bid submission.

**2. DEFINITIONS**

- A. *Agreement:* The written instrument which is evidence of the agreement between Owner and Contractor covering the Work.
- B. *Contract Documents:* Those items so designated in the Agreement. Only printed or hard copies of the items listed in the Agreement are Contract Documents. Approved Shop Drawings, other Contractor submittals, and the reports and drawings of subsurface and physical conditions are not Contract Documents.
- C. *Contractor:* The individual or entity with whom the Owner has entered into the Agreement.
- D. *Owner:* The individual or entity with whom Contractor has entered into the Agreement and for whom the Work is to be performed. The Owner for this project is the City of Newark.
- E. *Shop Drawings:* All drawings, diagrams, illustrations, schedules, and other data or information which are specifically prepared or assembled by or for Contractor and submitted by Contractor to illustrate some portion of the Work.
- F. *Site:* Lands or areas indicated in the Contract Documents as being furnished by Owner upon which the Work is to be performed, including rights-of-way and easements for access thereto, and such other lands furnished by Owner which are designated for the use of Contractor.

- G. *Subcontractor* – An individual or entity having a direct contract with Contractor or with any other Subcontractor for the performance of a part of the Work at the Site.
- H. *Work*: The entire construction or the various separately identifiable parts thereof required to be provided under the Contract Documents. Work includes and is the result of performing or providing all labor, services, and documentation necessary to produce such construction, and furnishing, installing, and incorporating all materials and equipment into such construction, as required by the Contract Documents.

### **3. BID SECURITY**

Each bid must be accompanied by a certified check, cashier's check, or bid bond in the amount of five percent (5%) of the proposed bid price, payable to the City of Newark. Failure to provide the required bid security may be grounds for rejection of the bid. If the successful bidder fails or refuses to execute and deliver the contract within fourteen (14) calendar days after receiving notice of the award of the contract, the successful bidder shall forfeit to the City for such failure or refusal the security deposited with the bid. Any certified check or cashier's check submitted as security shall be returned to all unsuccessful bidders sixty (60) calendar days after the bid opening date. The successful bidder shall provide the City with a Contract Surety Bond in the full amount of the contract guaranteeing faithful performance of the contract. Such bond shall be provided to the City with the executed contract within fourteen (14) calendar days after receiving notice of award of the contract. Upon receipt of the contract surety bond, the City will return any certified check or cashier's check submitted as bid security by the successful bidder.

### **4. TAXES**

The price(s) quoted shall not include federal or state taxes. If applicable, the successful bidder shall provide the City with three (3) copies of the required tax exemption forms to accompany the bidder's invoice.

### **5. AWARDS**

The City Manager will review each of the bids submitted and make a recommendation to the City Council on the disposition of the bids. The City Council reserves the right to accept or reject any or all bids or parts of bids as they may determine and to waive any irregularities or defects where the best interest of the City would be served.

### **6. BID PRICE**

The bid price shall include all transportation, delivery, installation and all charges for the goods and services specified to complete the work identified for each individual bid item. The work done under this contract will be funded by the City of Newark. The State of Delaware prevailing wage schedule will therefore not be applicable to this contract.

## **7. COMPLETION DATE AND TIMES**

The Contract will have a start date of July 15, 2018. The project completion date is December 31, 2018. Liquidated damages of five hundred dollars (\$500.00) per day may be assessed to the Contractor by the City for each day the contract is extended beyond the completion date. Liquidated damages are not to be construed as a penalty in any sense.

## **8. INTENT OF SPECIFICATIONS**

It shall be the contractor's responsibility to furnish the goods and services specifically indicated in the scope of work and specifications and such other as may be required to meet the intent of the specifications, drawings, or as may be necessary to provide the operation intended by the City.

## **9. EXCEPTIONS/DESCRIPTIVE INFORMATION**

Any and all exceptions which are taken to the specifications must be noted in the space provided on the proposal. Any exception to the specifications may be grounds for rejection of the bid.

## **10. EQUALS**

Where a product is specified by catalog or model number, the acceptability of any other "or approved equal" product shall be subject to the sole judgment of the City of Newark.

## **11. WARRANTIES AND STANDARDS**

All goods are to be new and unused in all component parts, including all accessories. The specifications will be construed as the minimum required. When the manufacturer's standard exceeds the specifications, the standard units will be furnished. All materials shall be free of defects. All standard manufacturer's warranties and guarantees shall apply to equipment and goods supplied under this contract.

All goods and materials shall be produced or manufactured in the United States, unless otherwise approved in writing. Appropriate documentation shall be provided with all goods and material submittals.

## **12. WORKMANSHIP**

Workmanship will conform to the best current manufacturing practice followed for goods of this type. Component parts and units will be manufactured to definite standard dimensions with proper fit and clearances.

### **13. FINAL INSPECTION**

All delivered goods and services will be subject to inspection by the City of Newark, Delaware. If in any way an item fails to meet the terms of the contract, it may be rejected or liquidated damage charges made. The decision of the City will be final and any rejected items or materials will have to be replaced at the expense of the vendor.

### **14. ADVERTISEMENTS**

Any bidder submitting a bid will not use the name of the City in any advertisement without first obtaining the written consent of the City Manager.

### **15. EEO AND BUSINESS LICENSES**

The bidder shall possess all required business or other licenses and also shall be a fair and equal opportunity employer.

### **16. NON-COLLUSION**

The bidder shall not, either directly or indirectly, enter into any agreement, participate in any collusion, or otherwise take any action in restraint of free competitive bidding in connection with the contract.

### **17. ADDENDA AND QUESTIONS**

Any changes to the contract documents shall be made by written addenda, issued no later than four (4) calendar days prior to the bid opening date. Bidders shall bear the entire responsibility for being sure they have received all such addenda.

Any questions regarding the bidding process should be directed to Ms. Cathy Trykowski, Purchasing Administrator, at [ctrykowski@newark.de.us](mailto:ctrykowski@newark.de.us) or (302) 366-7000. Any questions regarding the technical specifications should be directed to Mr. Timothy Filasky, PE, Acting Director, Water Resources and Public Works, at [tfilasky@newark.de.us](mailto:tfilasky@newark.de.us) or (302) 366-7000.

### **18. PAYMENT**

No invoice will be processed for payment until the goods and/or services have been delivered and verification is made that the specifications under this contract have been met. Progress payments, when requested, will be evaluated and approved for payment based on work completed to date according to the approved schedule of values. Payment for material stored on-site will be made at 50% of the material's invoice price. Full payment will be made after the material is installed. Payment will be made within thirty (30) days of final acceptance by the City.

## 19. BIDDERS QUALIFICATIONS

No contract will be awarded to any bidder who in the judgment of the City is not a responsible bidder, or is not prepared with all the necessary experience, capital, organization and equipment to conduct and complete the work for which the bidder proposes to contract.

EACH BIDDER SHALL SUBMIT WITH THE BID A LIST OF AT LEAST FIVE REFERENCES FOR COMPLETED PROJECTS WHICH MUST INCLUDE CONTACT PERSON, AGENCY AND PHONE NUMBER.

## 20. LIABILITY INSURANCE

- A. Except as otherwise provided by law, the contractor shall at all times maintain and keep in force such insurance as will protect him from claims under Worker's Compensation Acts, and also such insurance as will protect him and the owner from any such claims for damages for personal injuries, including death, which may arise from operations under this contract, whether such operations be by the contractor or by any subcontractor or anyone directly or indirectly employed by any of them.
- B. To be eligible to bid the project, the Prime Contractor shall be required to provide a letter stating an insurer is prepared to provide coverage. Formal proof of coverage will be required prior to signing the contract.
- C. The Prime Contractor shall be required to provide Commercial General Liability (CGL) coverage with limits of insurance not less than:

- \$2,000,000 Each Occurrence Limit
- \$2,000,000 Personal & Advertising Injury Limit
- \$3,000,000 Annual Aggregate Limit
- \$3,000,000 Products-Completed Operations Limit
- \$1,000,000 Business Auto Liability Limit
- \$5,000,000 Commercial Umbrella Limit

The Prime/General Contractor, The City of Newark (Owner), Johnson Mirmiran & Thompson (JMT) Inc., and all other parties required of the general contractor shall be included as insured on the CGL, using Additional Insured Endorsements providing coverage as broad as the coverage provided for the named insured subcontractor.

Subcontractors approved in association with the hiring of a Prime Contractor shall be required to provide Commercial General Liability (CGL) coverage with limits of insurance not less than:

- \$1,000,000 Each Occurrence Limit
- \$1,000,000 Personal & Advertising Injury Limit

\$2,000,000 Annual Aggregate Limit  
\$2,000,000 Products-Completed Operations Limit  
\$1,000,000 Business Auto Liability Limit  
\$3,000,000 Commercial Umbrella Limit

D. All Contractors shall provide Contractors Pollution Liability with limits not less than:

Each Claim or Occurrence	\$3,000,000
Annual Aggregate	\$3,000,000

The Contractors Pollution Liability policy shall include coverage for Emergency Response Costs, Contingent Transportation, Non-Owned Disposal Sites, and Natural Resource Damage. If coverage is written on a claims-made basis, an Extended Reporting Period, or tail coverage, shall be provided for thirty (30) days following completion of the insured's services. In the alternative, the Contractors Pollution Liability policy shall be renewed for not less than thirty (30) days following completion. The policy retroactive date shall be no later than the effective date of this Agreement.

## **21. ITEMS TO BE EXECUTED AND SUBMITTED WITH BID**

Bidders are notified that the proposal, non-collusion statement, insurance documentation, bid security, **and all other submittals as outlined in the technical specifications** must be executed and completed in full and submitted with the bid at the time of bidding, or bid may be subject to rejection.

## **22. ITEMS TO BE SUBMITTED WITH SIGNED CONTRACT**

- A. Construction Schedule
- B. Construction Bond
- C. Insurance Documentation

## **23. RETAINAGE**

The City will retain 5% of the progress payments until such time as the project is complete and accepted by the City.

## **24. GUARANTEE**

The contractor shall guarantee the work, materials, and equipment and the other Contract performances, and shall remedy, without cost to the Owner, any defects that may develop therein during a period of one year from the date of the Owner's acceptance of the Certificate of Substantial Completion.

## **25. INDEMNIFICATION**

The contractor shall solely be responsible and liable for the accuracy and completeness of all work performed and shall agree to indemnify, defend and hold harmless the City of Newark, its officers, agents and employees, from and against any and all claims, actions, suits and proceedings arising out of, based upon or caused by negligent acts, omissions or errors of or the infringement of any copyright of patent, by the contractor, its officers, agents, employees or subcontractors, in the performance of the contracted agreement.

## **26. TERMINATION OF AGREEMENT**

This agreement may be terminated by the City upon thirty (30) days written notice if the contractor fails to perform satisfactorily in accordance with the terms and conditions of the contract. In the event this agreement is terminated, the contractor shall be paid for services satisfactorily rendered up to the termination date.

## **27. FAMILIARITY WITH PROPOSED WORK**

A complete understanding of the conditions as they exist is required by careful personal examination of the work at the site. Each contractor bidding must completely satisfy himself as to the exact nature and existing conditions of the work area and treatment facility. The contractor also shall examine carefully the plans, if any, specifications and the contract forms for the work contemplated. Failure to do so will not relieve the successful contractor of his obligation to carry out the provisions of the contract.

The contractor shall not, at any time after the execution of the contract, set up any claims whatever based upon insufficient data or incorrectly assumed conditions, nor shall claim any misunderstanding in regard to the nature, conditions or character of the work to be done under this contract, and shall assume all risks resulting from any change in the conditions which may occur during the progress of the work.

## **28. CONTRACTOR'S UNDERSTANDING**

It is understood and agreed that the contractor has, by careful examination, satisfied himself as to the nature and location of the work, the conformation of the ground; the character, quality and quantity of the material which will be required; the character of equipment needed preliminary to and during the prosecution of the work; the general and local conditions; all permit restrictions and conditions; and all other matters which can in any way affect the work under this contract. No verbal agreement or conversation with any officer, agent or employee of the City of Newark, either before or after the execution of this contract, shall affect or modify any of the terms or obligations herein contained.

## **29. SAFETY REQUIREMENTS**

The Contractor shall comply with the requirements and standards of the Occupational Safety and

Health Act and all other state and local laws, ordinances and codes governing all work to be provided under the contract documents.

The Contractor shall maintain on-site and in all vehicles at all times spill response equipment appropriate for the types and quantities of fluids and/or materials that may be subject to spillage during the project. All discharges to the storm drainage system or surface waters are strictly prohibited. In the event that a spill reaches the storm drainage system and/or surface waters, the contractor shall notify the Public Works and Water Resources Department immediately at 302-366-7000. The Contractor will also be responsible for spill response and clean-up at no cost to the owner. If the Contractor fails to respond to and clean up a spill to the satisfaction of the owner, the owner will perform clean up and bill the Contractor for 150% of the personnel time and material expenses incurred by the City as necessary for the response.

### **30. RESTORATION OF DISTURBED AREAS AND CLEAN UP**

Upon completion of the work, all related work, such as lawns, curbs, sidewalks, fences, shrubbery, and driveways that have been disturbed shall be restored to their original condition and in accordance with City of Newark Standards and Specifications. The area shall be cleared of all tools, equipment and refuse resulting from the project. The contractor shall, at the end of each day, leave the areas in which he has worked, free of debris and safely secure his material and equipment.

### **31. INSPECTION OF MATERIAL AND WORK**

- A. Workmanship shall be of good quality and all work and material shall be at all times subject to the inspection of the City of Newark or their duly authorized representatives. The contractor shall provide reasonable and necessary facilities for such inspection. If required by the City of Newark, the contractor shall take down or uncover portions of the finished work.
- B. The contractor agrees that in case any of the material or work, or both, shall be rejected as defective or unsuitable by the city, material and the work shall be done again immediately to the satisfaction and approval of the city at the cost and expense of the contractor.
- C. Any omission or failure on the part of the City of Newark or inspectors to disapprove or reject any defective work or materials shall not be construed to be an acceptance of any defective work or material.
- D. In case the city should not consider the defect of sufficient importance to require the contractor to replace any imperfect work or materials, the city shall have the power to make an equitable deduction from the stipulated price.

- E. Neither the inspection nor supervision of the work, nor the presence or absence of an inspector shall relieve the contractor of any of his obligations under the contract or of making his work conform to the specifications.

### **32. DEBRIS COLLECTION AND DISPOSAL**

The Contractor is responsible for collection, removal, transport and lawful disposal of construction debris and or materials.

### **33. OWNERSHIP OF MATERIAL**

All documents prepared and submitted pursuant to this RFP or contract shall be property of the City upon submittal and will be subject to staff and public review and discussion in association with our public bidding and formal proposal process. Any information or documents deemed proprietary shall be so marked at time of submittal and limited to detail where the disclosure of contents could be prejudicial to competing offerors during the process of negotiation, and any commercial or financial information of a privileged or confidential nature.

CITY OF NEWARK

Delaware

CONTRACT NO. 18-04

CORRUGATED METAL PIPE (CMP) LINING - 2018

SCOPE OF WORK

**1. DESCRIPTION**

The project involves the rehabilitation of storm sewer piping consisting of corrugated metal located throughout the City of Newark, Delaware. The Drawings further define the scope of work. The Contractor shall furnish all required equipment, materials, and labor necessary for completion of the work.

**2. LOCATION**

Various locations throughout the City of Newark.

**3. PERMITS, CERTIFICATIONS, LAWS AND ORDINANCES**

The Contractor is required to have or obtain a City Contractors License prior to starting the work. The Contractor is required to obtain any building permits required for completion of the work. The fees for City of Newark permits will be waived.

The Contractor shall perform the work in accordance with all local, state and federal laws and ordinances.

**4. COORDINATION**

- A. Contractor shall coordinate construction operations with those of other contractors and entities to ensure efficient and orderly installation of each part of the Work. Contractor shall coordinate its operations with operations that depend on each other for proper installation, connection, and operation.
- B. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
- C. Coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair.
- D. Make adequate provisions to accommodate items scheduled for later installation.

- E. Contractor is required to notify in writing via door hangers all properties located adjacent to or directly affected by the Contractors work.

## **5. SUBMITTALS**

The Contractor should provide submittals for review and approval in PDF format. For scheduling purposes, the Contractor shall allow for fourteen (14) day review time by the City. The Contractor shall provide the following submittals to the Owner for review and approval:

- A. Construction Schedule
- B. Contractor shall submit a sketch of the project area showing the required staging and storage area to the Owner for review.
- C. Shop drawings for all proposed materials and equipment as outlined in the technical specifications.
- D. Door hanger used for notifications.

## **6. RESTORATION**

The Contractor is responsible to restore all disturbed areas to original or better condition and remove all debris, residuals, trash, and excess materials from the sites.

## **7. SECURITY AND SITE ACCESS**

The Contractor is responsible for security of his equipment and materials related to the work.

The Contractor is responsible to maintain the work sites in a safe and orderly manner.

Contractor shall have full use of Project site for construction operations during the construction period. Contractor's use of Project site is limited only by Owner's right to perform work or to retain other contractors on portions of Project.

Limit use of Project sites to work in areas indicated. Do not disturb portions of Project sites beyond areas in which the Work is indicated.

- A. Driveways, Walkways and Entrances: Keep driveways and entrances serving premises clear and available to Owner, Owner's employees, and emergency vehicles at all times. Do not use these areas for parking or storage of materials.
- B. Schedule deliveries to minimize use of driveways and entrances by construction operations.
- C. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.

## **8. WORK RESTRICTIONS**

- A. Comply with limitations on use of public streets and with other requirements of authorities having jurisdiction.
- B. On-Site Work Hours: Limit work at the site to normal business working hours of 7:00 a.m. to 5:00 p.m., Monday through Friday, unless otherwise indicated or approved by City of Newark.
- C. Any and all work within a DeIDOT right-of-way shall be in accordance with DeIDOT work restrictions and traffic control requirements which may require night time work activity inside the right-of-way when impacting the travel lanes.
- D. Weekend Hours: Weekend hours must be approved by the City.
- E. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after providing temporary utility services according to requirements indicated:
  - 1. Notify Owner not less than five days in advance of proposed utility interruptions.
  - 2. Obtain Owner's written permission before proceeding with utility interruptions.
- F. Noise, Vibration, and Odors: Coordinate operations that may result in high levels of noise and vibration, odors, or other disruption to Owner occupancy with Owner.
  - 1. Notify Owner not less than two days in advance of proposed disruptive operations.
  - 2. Obtain Owner's written permission before proceeding with disruptive operations.
- G. Controlled Substances: Use of tobacco products and other controlled substances on Project sites is not permitted.
- H. Contractor shall have contaminant spill response equipment readily available on-site during construction activity.

## **9. STARTING DATE AND SEQUENCE OF CONSTRUCTION**

The starting date of this contract will be specified by the City in a written "Notice to Proceed." A preconstruction meeting shall be scheduled to finalize the sequence of construction. The final decision as to the sequence of construction shall be that of the Engineer.

## **10. COORDINATION WITH THE CITY**

The Contractor shall coordinate all activities with the City. The Contractor shall provide the City with reasonable time to respond to requests for information and for coordination.

## **11. TECHNICAL SPECIFICATIONS**

Technical specifications as attached are included in the contract.

## **12. CONTRACT DRAWINGS**

Project drawings prepared by Johnson Mirmiran and Thompson (JMT), Inc., as provided are considered contract documents. See the cover sheet of the plan set for the list of drawings.

## **13. BID ITEMS**

Bidders must provide prices on the Proposal form including all adjustment bid items.

## **14. BASIS OF PAYMENT**

The quantity of pipe lining will be measured in linear feet along the bottom centerline as installed and accepted. All other items, methods, and materials necessary to complete the work described in each pay item shall be incidental to the bid item the work is being completed under.

The Owner reserves the right to delete from the Contract one or more items listed and the right to add or subtract from the quantity of each item. The total price to be paid will be adjusted in accordance with the Contractor's unit prices as required above. There will be no extra compensation or increase in unit prices in the Proposal if such additions and/or deletions are made to quantities.

## **15. LINING SYSTEM SELECTION**

It is the Contractors discretion as to which lining system they implement for each corrugated metal pipe segment. The Contractor is aware that by submission of their bid, the selected lining system for each pipe segment will meet or exceed the specifications for the lining system selected as outline in the contract documents.

## **16. BASIS OF DESIGN**

Below is a basis of design table for each pipe segment. It is the Contractors responsibility to notify the Owner of additional information required to complete the design of the selected lining system. Requests for information must be provided in writing to the Owner at least four days before bids are due.

ASSET ID	DEPTH OF COVER (FT)	GROUND WATER ELEVATION	OVALITY (%)	LOADING	LEVEL OF DETERIORATION	FACTOR OF SAFETY
CL00066	5	Crown of Pipe	2%	HS-20	Fully	2
CL00067	5	Crown of Pipe	2%	HS-20	Fully	2
PI02827	4	Crown of Pipe	2%	HS-20	Fully	2
PI02828	4	Crown of Pipe	2%	HS-20	Fully	2
PI01090	4	Crown of Pipe	2%	HS-20	Fully	2
CL00110	4	Crown of Pipe	-	HS-20	Fully	2
PI03120	4	Crown of Pipe	2%	HS-20	Fully	2
CL00092	4	Crown of Pipe	-	HS-20	Fully	2
CL00093	4	Crown of Pipe	-	HS-20	Fully	2

CITY OF NEWARK

Delaware

CONTRACT NO. 18-04

CORRUGATED METAL PIPE (CMP) LINING - 2018

PROPOSAL

To: The Mayor and City Council  
Newark, Delaware

From: \_\_\_\_\_

The undersigned as a lawfully authorized agent for the below named bidder has carefully examined the Bid Documents to be known as Contract No. 18-04 and bids himself on award to him by the Mayor and City Council of Newark, Delaware to execute in accordance with such award, a contract of which this Proposal and said General Provisions and Specifications and any Addenda shall be a part, and to furnish the goods as specified F.O.B. Newark, Delaware in a manner that is in complete accordance with said General Provisions and Specifications at the following named unit price on or before the delivery period stated below:

<u>Bid Item</u>	<u>Asset ID</u>	<u>Price / LF</u>	<u>Approximate Quantity (LF)</u>	<u>Total Amount</u>
1	CL00066		60	\$
2	CL00067		60	\$
3	PI02827		37	\$
4	PI02828		138	\$
5	PI01090		79	\$
6	CL00110		131	\$
7	PI03120		114	\$
8	CL00092		61	\$
9	CL00093		60	\$

Project to be completed by \_\_\_\_\_

DATE: \_\_\_\_\_ BIDDER: \_\_\_\_\_

By: \_\_\_\_\_  
Its legally authorized representative

PRINT NAME: \_\_\_\_\_

TITLE: \_\_\_\_\_

ADDRESS: \_\_\_\_\_

CITY, STATE, ZIP: \_\_\_\_\_

TELEPHONE: \_\_\_\_\_

CITY OF NEWARK

Delaware

CONTRACT NO. 18-04

CORRUGATED METAL PIPE (CMP) LINING - 2018

BOND TO ACCOMPANY PROPOSAL

(not necessary if certified or cashier's check is used)

KNOW ALL MEN BY THESE PRESENTS THAT \_\_\_\_\_  
of \_\_\_\_\_ of the County of \_\_\_\_\_  
and State of \_\_\_\_\_, principal, and \_\_\_\_\_  
of \_\_\_\_\_ as surety, legally authorized to do business in the  
State of Delaware, are held and firmly bound unto the City of Newark in the sum of  
\_\_\_\_\_  
\_\_\_\_\_ dollars, to be paid to said City of Newark for use  
and benefit of the Mayor and Council of Newark, for which payment well and truly to be made, we  
do bind ourselves, our and each of our heirs, executors, administrators and successors, jointly and  
severally, for and in the whole, Contractor by these presents. Sealed with our seal dated the \_\_\_\_\_  
day of \_\_\_\_\_ in the year of our Lord, two thousand  
\_\_\_\_\_ (20\_\_\_\_).

NOW THE CONDITIONS OF THIS OBLIGATIONS IS SUCH, that if the above bounded principal who has  
submitted to said City of Newark, a certain proposal to enter into a certain Contract No. 18-04,  
CORRUGATED METAL PIPE (CMP) LINING - 2018 and if said \_\_\_\_\_  
shall well and truly enter into and executes said contract and furnish therewith such Surety Bond or  
Bonds as may be required by the terms of said contract and approved by said City of Newark, said  
Contract, and said Bond to be entered into within fourteen (14) calendar days after the date of

official notice of award thereof in accordance with the terms of said proposal, then this obligation to be void, otherwise shall remain in full force and virtue.

SIGNED AND SEALED IN THE PRESENCE OF WITNESS:

SIGNED \_\_\_\_\_ (SEAL)

BY \_\_\_\_\_ (SEAL)

\_\_\_\_\_  
SIGNED \_\_\_\_\_ (SEAL)

BY \_\_\_\_\_ (SEAL)

CITY OF NEWARK

Delaware

CONTRACT NO. 18-04

CORRUGATED METAL PIPE (CMP) LINING - 2018

NON-COLLUSION STATEMENT

Date: \_\_\_\_\_

City of Newark  
Newark, Delaware

Gentlemen:

This is to certify that the undersigned bidder \_\_\_\_\_  
has not, either directly or indirectly entered into any agreement, participated in any collusion, or  
otherwise taken any action in restraint of free competitive bidding in connection with this proposal  
submitted to the City of Newark on the \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_.

Signature of Bidder: \_\_\_\_\_

By: \_\_\_\_\_  
Its legally authorized representative

Sworn to and subscribed before me on this \_\_\_\_\_ day of \_\_\_\_\_ 20\_\_.

My Commission expires \_\_\_\_\_

\_\_\_\_\_  
Notary Public

## **SECTION 01 00 00**

### **CURED IN PLACE PIPE (CIPP) STRUCTURAL LINING SYSTEM**

#### **PART 1 GENERAL**

##### **1.1 SUMMARY:**

This specification covers work, materials and equipment required for the preparation and installation of a Cured In Place (CIPP) liner providing a minimum 50-year design life for internal protection and structural rehabilitation. This work shall consist of installing a resin-impregnated flexible tube, which is tightly formed to the host pipe. The resin is then cured using either hot water under hydrostatic pressure within the tube, steam pressure within the tube, or cured using ultra-violet light. The Cured-In-Place Pipe (CIPP) will be continuous and tight fitting and will act as a structural pipe liner. The protection lining works shall include all activities associated with the protection lining system, not limited to the following:

1. Design of approved continuous protection liners to the internal surface of the host pipe.
  2. Pre-construction inspection, cleaning, and surface preparation of host pipe prior to application of protection lining system.
  3. Installation of approved continuous protection liners to the entire internal surface of the host pipe, manhole to manhole, manhole to structure, or structure to structure. Partial liner installations, unless directed by the Owner, are not allowed.
  4. Quality Control Measures.
  5. Post-construction inspection, testing, and repairs.
  6. Warranty inspection, testing, and repairs.
- A. Work also includes preparatory work and operations necessary to mobilize and demobilize for the project. Work includes:
1. Mobilization and setting up operation on the project site with personnel, equipment, supplies, and accessory items.
  2. Scheduling details, coordination, and any other work and expense appropriate that is prior to start of work under other Contract pay items.
  3. Demobilization, of above items until the completion of project.
- B. Work also includes the following:
1. Removal and disposal of debris.

##### **1.2 REFERENCES: NOT USED**

##### **1.3 DEFINITIONS: NOT USED**

#### 1.4 QUALITY ASSURANCE:

- A. Product Manufacturer: Company specializing in manufacturing quality CIPP liner products with minimum 5-years' experience. Company shall submit five (5) references for installation of proposed product within the last five (5) years.
- B. The Contractor and/or Subcontractor shall be able to demonstrate that they have successfully completed a minimum of 5,000 linear (LF) of CIPP lining rehabilitation. The Contractor shall submit references meeting these requirements. The references shall include size/diameter of pipe, length of installation; size of bypass pumping required for performing the work, name and telephone number of the owner and date of installation.
- C. Single Source Responsibility: Use only products approved by CIPP liner Manufacturer and use only within recommended limits.
- D. Testing: Structural rehabilitation products submitted for approval shall provide third party test results supporting the structural performance of the product and such data shall be satisfactory to the City of Newark. No product will be approved without independent third-party testing verification.
- E. All requested documented experience must be based on the experience of the "Company" and not on the experience of an individual within the organization.
- F. The Contractor shall submit a certified statement from the manufacturer that he/she is a certified and/or licensed installer of the liner.
- G. Personnel Experience: Foreman shall have a minimum of three (3) years of continuous experience with the installation of CIPP.
- H. The City of Newark reserves the right to approve or disapprove the Contractor, based on the submitted qualifications.

#### 1.5 COORDINATION WITH OTHERS

- A. Contractor shall notify residents, businesses and all other authorities of project related roadway and traffic impacts. The work shall be coordinated with these authorities on a daily basis to avoid any conflict. Should the Contractor not perform notifications at least 48-hours in advance of their work, the City reserves the right to stop work until residents, businesses, etc. have had 48-hours notice of proposed work.
- B. Potable water is available at no cost to the Contractor at the City of Newark's Municipal Maintenance Yard located at 406 Phillips Avenue, Newark DE 19711. Contractor shall not use any hydrants within the distribution system to obtain potable water. All water shall come from the Municipal Maintenance Yard.

#### 1.6 SUBMITTALS

- A. General: Provide all submittals, including the following in accordance with the requirements contained in the General Requirements.
- B. This section lists items that shall be **submitted at the time of bid:**

1. CIPP material and design submittals: In order to compare bid proposals, the Contractor shall submit the specific CIPP material proposed for the project with a material data sheet that shows it meets or exceeds all material properties in this specification.
  2. A preliminary design showing the proposed liner thickness for the project. Preliminary designs do not need to be sealed by a professional engineer in the state of Delaware. Once project is awarded, Contractor is responsible to submit signed and sealed final designs.
- C. All test reports, samples, minimum liner thickness calculations, and applicator qualifications shall be submitted to the City for review and approval prior to any field work taking place.
- D. Product Literature and Samples to be submitted prior to any field work:
1. Submit representative samples and related product literature of materials being used, including names, material characteristics, and physical and structural properties, sources, and descriptions. Include required substrate preparation, on-site quality assurance recommendations and a list of all materials to be used.
  2. Submit manufacturer's recommendations for shipping, storage and handling of all components of the CIPP lining materials. Manufacturer's recommended pressures, temperatures, and duration of curing shall also be submitted.
  3. Manufacturer's standard size cured sample of showing the installed lining system to be expected in the finished Work. Show the full thickness, or a typical thickness when underlayment requirements will vary, of system with all components in place. The CIPP lining must be at full thickness. Samples submittals will be reviewed for floor, texture, and pattern only. Compliances with other requirements is the sole responsibility of the Contractor.
  4. Liner design sealed by a Professional Engineer licensed in the State of Delaware.
- E. Health and Safety Plan (HASP) specific for all aspects of the cleaning operations and debris removal/disposal and coordination with the aforementioned required cleaning plans. Employee safety, HASP adequacy and regulatory compliance are the sole responsibility of the Contractor. The City will confirm that the Contractor's HASP exists, but neither will comment, approve or disapprove the plan.
- F. Before any field work by the Contractor, the Contractor shall submit the following to the City to review:
1. Manufacturer-certified copies of all test reports on each product used, including ASTM test results indicating the product conforms to and is suitable for its intended use per these specifications material properties.
- G. Certificates: Submit certificates proving that personnel performing the work are qualified to the level required in these specifications. List personnel by name with capabilities, projects, and duties performed on those projects. Prove written certification of compliance with the ASTM standards cited in this specification.

- H. Detailed plan for weather monitoring during CIPP application and, when applicable, traffic control methods and inventory of the equipment proposed for this operation.
- I. The Contractor shall submit the following information the same day as the installation:
  - 1. Daily Activity Logs and Field measurements as stated herein.
  - 2. Daily confined space entry form for each manned entry made. Contractor is responsible for confined space permitting.
- J. After cleaning and TV inspection by the Contractor of all proposed pipe and structures to be rehabilitated and before beginning lining any pipe or structure, the Contractor shall submit the following to the City for review:
  - 1. DVD and log (1 copy of both) of the Contractor's TV inspection of the pipe or structure prior to product application in a format acceptable to the City.
- K. After rehabilitation of the pipe or structure, the Contractor shall submit the following to the City of Newark for record purposes:
  - 1. DVD and log (1 copy of both) of the Contractor's TV inspection of the Completed Work in a format acceptable to the City.
  - 2. Test results of samples of CIPP liner as specified in the contract documents.

#### 1.7 DELIVERY, STORAGE, AND HANDLING:

- A. Delivery: Deliver materials in original containers with seals unbroken and labels intact and free of moisture. Do not use materials that have been exposed to moisture or if there is visible damage to the packaging.
- B. Receipt Process: All materials must be inspected upon receipt and properly documented as to the amount of material and the identification of the material by batch numbers. Dates and times along with the shipping company delivering the material should be recorded for possible future reference.
- C. Storage: Contractor shall designate a specific space at the project site for storing and mixing materials. Protect this space and repair all damage resulting from use. Do not store kerosene nor gasoline in this space. Remove oily rags at the end of each day's work. Products are to be kept dry, protected from weather and stored under cover within the temperature ranges recommended by the manufacturer. Products are to be stored and handled according to their MSDSs or appropriate classification. Damaged or unsuitable products shall be promptly removed from the job site and shall be replaced with suitable materials.

#### 1.8 PROJECT CONDITIONS:

- A. Environmental Requirements: Contractor shall conform with all local, state and federal regulations including those set forth by OSHA and the EPA and any other applicable authorities. Confined space entry requirements shall be followed. Contractor is responsible for following all OSHA confined space regulations and for ensuring all workers are wearing the proper personal protective equipment (PPE) and monitoring equipment.

- B. Provide continuous ventilation and if necessary cooling and heating facilities to maintain surface and ambient temperatures before, during, and following application of finishes, within temperature range and for duration as directed by manufacturer.
- C. Protection: Provide sufficient shielding to fully protect adjacent finished work.
- D. Safety: Contractor shall consider the structure as a confined space. The OSHA Regulation Document, CFR 29, Part 1910.146 considers storm pipes confined spaces. Personnel must have the adequate training in confined space. Personnel shall follow all OSHA regulations in terms of training, equipment, monitoring, personal protective equipment (PPE), and all other requirements.
- E. Weather: Contractor shall take weather into consideration when scheduling work. Contractor is liable for any complications that arise from weather.

#### 1.9 CLEANING:

- A. It is the intent of this contract that the storm pipe, structures, and all other appurtenances be cleaned and inspected within the project limits as defined by these contract documents. The Contractor is responsible for all procedures of accessing and cleaning as necessary to complete the work required prior to CIPP lining.
- B. The Contract Drawings provide details showing the access points for cleaning the structure and pipes. It is the responsibility of the Contractor to include personnel on their team as necessary to successfully and safely conduct the work as shown on the contract drawings and to execute the planned work approach (means and methods).
- C. Cleaning procedures shall include the use of equipment adequate to clean and remove all debris that hinders CCTV and surface preparation prior to CIPP lining. Debris may include, but is not limited to roots, trash, gravel, silt, clay, bottles, wood, rocks, metallic debris, cloth materials, leaves, organic material, rags, and other materials in the pipe and structures.
- D. The sediment and other settled materials have not been characterized in a laboratory. The Contractor shall anticipate that sediment and other settle materials shall be of variable consistency ranging from runny, quick-sand type material to firm, clay-like to solid materials with any of the aforementioned debris interspersed in the sediment.

#### 1.10 DISPOSAL OF MATERIALS:

- A. All waste materials, including but not limited to extracted materials from the storm pipe and structures, excess construction materials, and other debris shall become the property of the Contractor. In all cases, the Contractor shall collect and transport all materials of all kinds removed from the storm pipe and structures. The Contractor shall dispose of all such materials in accordance with the approved disposal plan at no additional cost to the City. No additional payment will be made for separating materials as required by the approved disposal facility (i.e. separating trash from sediment) or disposing of materials separately.
- B. The Contractor shall prepare a Disposal Plan for review and approval by the City prior to performing any work that might generate waste materials. The plan shall include a complete description of the materials that are expected to be encountered, dewatering procedures and their proposed disposal site(s).

- C. The Contractor shall be responsible for obtaining all Federal, State and Local permits related to the disposal operations and the Contractor shall comply with all requirements of those permits.

#### 1.11 QUALITY CONTROL:

##### A. Quality Control, Sampling and Testing:

1. Chemical Resistance – The CIPP shall meet the chemical resistance requirements of ASTM F1216, Appendix X2. CIPP samples for testing shall be of tube and resin system similar to that proposed for actual construction. It is required that CIPP samples with and without plastic coating meet these chemical-testing requirements.
2. CIPP Field Samples – When requested by the Owner, the Contractor shall submit test results from field installations of the same resin system and tube materials as proposed for the actual installation. These test results must verify that the CIPP physical properties specified herein have been achieved in previous field applications. Samples for this project shall be made and tested as described in this specification.

##### B. Daily Activity Logs:

1. A Daily Activity Log will be filled out completely anytime a work crew is on site. This log includes listing the personnel present at the site, when they arrived and when they left the site.
2. The operating conditions are also recorded. These measurements include the water addition rate taken at the meter tube, the retrieval speed of the retraction system and the pump motor speed recorded at the pump.
3. Any special conditions are to be noted in the daily log.

##### C. Equipment Calibration Reports:

1. Equipment calibration reports are to be maintained at all times for inspection by the City's staff.

##### D. Final Inspection:

1. Inspection of the lining products and materials may also be made by the City after delivery. The lining products and materials shall be subject to rejection at any time on account of failure to meet any of the Specification requirements, even though samples may have been accepted as satisfactory at the place of manufacture. Lining materials rejected after delivery shall be marked for identification and shall be removed from the job immediately.

#### 1.12 WARRANTY:

- A. Contractor shall warrant all work against defects in materials and workmanship for a period of two (2) years, unless otherwise noted, from the date of the Warranty Inspection. The Warranty Inspection shall occur at least twelve (12) months after the final acceptance of the project, but not more than 18 months afterwards. Contractor shall, within a reasonable time after receipt of written notice thereof (but not more than 120 calendar days), repair or replace defects in materials or workmanship which may

have developed since the date of Final Acceptance, and any damage to other work caused by such defects or the repairing of same, at his or her own expense and without cost to the City of Newark.

- B. The Contractor shall also warrant the City of Newark so that the materials used on this contract, where covered by patents or license agreements, are furnished in accordance with such agreements and that the prices included herein cover all applicable royalties and fees in accordance with such license agreements. The contractor shall defend, indemnify and hold the City of Newark harmless from and against any and all costs, loss, damage or expense arising out of or in any way connected with any claim of infringement of patent, trademark or violation of license agreement.

## **PART 2 PRODUCTS**

### **2.1 EXISTING PRODUCTS:**

- A. Existing pipe will consist of corrugated metal.

### **2.2 ACCEPTABLE MATERIALS:**

- A. Tube:
  - 1. The sewn tube shall meet the requirements of ASTM F1216, ASTM F1743, ASTM D 5813, or ASTM F-2019. The tube shall be constructed to withstand installation pressures, have sufficient strength to bridge missing pipe, and stretch to fit irregular pipe section. The tube may also contain felt layers reinforced with glass, carbon fibers, or glass reinforced fabric.
  - 2. The wet out tube shall have a uniform thickness that when compressed at installation pressures will equal or exceed the calculated minimum design CIPP wall thickness.
  - 3. The tube shall be manufactured to a size that when installed will tightly fit the internal circumference and length of the host pipe. Allowance should be made for circumferential stretching during installation.
  - 4. For felt tubes, the outside layer of the tube shall be coated with an impermeable, flexible membrane that will contain the resin and allow the resin impregnation (wet out) procedure to be monitored.
  - 5. The tube shall contain no intermediate or encapsulated elastomeric layers. No material shall be included in the tube that may cause delamination in the cured CIPP. No dry or unsaturated layers shall be evident.
  - 6. The wall color of the interior pipe surface of CIPP after installation shall be a relatively light reflective color so that a clear detailed examination with closed circuit television inspection equipment may be made.
  - 7. Seams in the tube shall be stronger than the non-seamed felt material.
  - 8. The tube shall be marked for distance at regular intervals along its entire length, not to exceed 5 ft. Such markings shall include the Manufacturer's name or identifying symbol. The tubes must be manufactured in the USA.

B. Resin:

1. The resin system shall be a corrosion resistant polyester or vinyl ester system including all required catalysts, initiators that when cured within the tube create a composite that satisfies the requirements of ASTM F1216, ASTM D5813, ASTM F1743, or ASTM F2019 (whichever is applicable) the physical properties herein, and those which are to be utilized in the submitted and approved design of the CIPP for this project. The resin shall produce a CIPP that will comply with the structural and chemical resistance requirements of this specification.

2.3 CIPP CHARACTERIZATION TECHNIQUES: NOT USED

2.4 CIPP DESIGN:

- C. The CIPP shall be designed as per ASTM F1216, Appendix X.1. The CIPP design shall assume no bonding to the original pipe wall.
- D. The Contractor must have performed long-term testing for flexural creep of the CIPP pipe material installed by his Company. Such testing results are to be used to determine the long-term, time dependent flexural modulus to be utilized in the product design. This is a performance test of the materials (Tube and Resin) and general workmanship of the installation and curing as defined within the relevant ASTM standard. A percentage of the instantaneous flexural modulus value (as measured by ASTM D790 testing) will be used in design calculations for external buckling. The percentage, or the long-term creep retention value utilized, will be verified by this testing. Retention values exceeding 50% of the short-term test results shall not be applied unless substantiated by qualified third party test data to the Owner's satisfaction. The materials utilized for the contracted project shall be of a quality equal to or better than the materials used in the longterm test with respect to the initial flexural modulus used in the CIPP design.
- E. The layers of the CIPP shall be uniformly bonded. It shall not be possible to separate any two layers with a probe or point of a knife blade so that the layers separate cleanly or the probe or knife blade moves freely between the layers. If the layers separate during field sample testing, new samples will be required to be obtained from the installed pipe. Any reoccurrence may cause rejection of the work.
- F. The cured pipe material (CIPP) shall conform to the structural properties, as listed below.

MINIMUM CIPP PHYSICAL PROPERTIES

Property	Test Method	Min. per ASTM F1216	Cured Polyester Composite Enhanced Resin
Modulus of Elasticity	ASTM D790	250,000 psi	400,000 psi
Flexural Stress	ASTM D790	4,500 psi	4,500 psi

- G. The required structural CIPP wall thickness shall be based as a minimum, on the physical properties above or greater values if substantiated by independent lab testing and in accordance with the design equations in the Appendix X1. Design Considerations of ASTM F1216, and the following design parameters to be completed per segment:

1. Design Safety Factor = 2.0
2. Retention Factor for Long-Term Flexural Modulus to be used in Design = 75%
3. Ovality\* (calculated from (X1.1 of ASTM F1216) = 2 %
4. Groundwater Depth (above invert of existing pipe) = \_\_\_\_\_ ft.
5. Soil Depth (above crown of existing pipe) = \_\_\_\_\_ ft.
6. Soil Modulus = 700 psi
7. Soil Density = 125 pcf
8. Live Load = HS20

- H. Any layers of the tube that are not saturated with resin prior to insertion into the existing pipe shall not be included in the structural CIPP wall thickness computation.
- I. Overall, the hydraulic cross-section shall be maintained as large as possible. The CIPP shall have a minimum of the full flow capacity of the original pipe before rehabilitation. Calculated capacities may be derived using commonly accepted roughness coefficient for the existing pipe material taking into consideration its age and condition.

2.5 PHYSICAL PROPERTIES: NOT USED

2.6 CIPP APPLICATION EQUIPMENT: NOT USED

2.7 EQUIPMENT MAINTENANCE:

- A. All equipment shall be clean and in good working condition.
- B. Maintenance and service shall be performed on the equipment to Manufacturer's standards.

## **PART 3 EXECUTION**

3.1 PRE-CONSTRUCTION INSPECTIONS:

- A. Prior to lining, the Contractor's experienced personnel trained in the inspection of pipes shall clean and CCTV inspect the pipe, in accordance with the Contract Documents, accurately measure the existing pipes, and verify that host pipe dimensions are as per the plans to verify the requirement of the liner installation. Notify the City if conditions exist which will impact the installation. If the CCTV inspection shows an obstruction that will interfere with the proper liner installation, the Contractor shall remove the obstruction of defect prior to initiating lining.

Debris, sediment, rocks, and trash are not considered obstructions and should be removed via cleaning, as required in these specifications.

### 3.2 SURFACE PREPARATION AND PRE-LINING REPAIRS:

- A. The floor and interior walls of the pipe shall be thoroughly cleaned and made free of all foreign materials including dirt, grit, roots, grease, sludge, rocks, trash, and all debris or material that may be attached to the wall or bottom of the pipe.
1. High pressure water blasting with a minimum of 3,500 psi shall be used to clean and free all foreign material within the pipe.
  2. When grease and oil are present within the pipe, water may be heated to 200° F or an approved detergent shall be used integrally with the high-pressure cleaning water.
  3. All materials resulting from the cleaning of the pipe or structure shall be removed prior to application of the CIPP material and properly disposed of. Cleaning, removing, and disposal of debris from pipes or structures, as shown on the plans, is considered incidental to CIPP lining.
  4. Cleaning equipment used shall include, but shall not be limited to, rodding machines, dragging machines, and high velocity pressure washers as best suited for the particular task. Only equipment designed for cleaning of large diameter lines may be used.
  5. Dragging machine shall include appurtenances such as scrappers, squeegees, buckets, and porcupines. Selection of any equipment shall be based on field conditions such as terrain, access to manholes, structures, type of debris, size of pipe, and the conditions of lines at the time the work commences.
  6. The cleaning equipment shall be capable of removing dirt, rocks, sand, stones, trash, mud, wood, bricks, and other materials and obstructions from the storm pipes and structures.
  7. Backup equipment shall be available and capable of being delivered to the site within 24 hours.
  8. If the cleaning process reveals that the pipe invert, crown or sidewalls are deteriorated, measures will be taken to provide a continuous slope to the pipe, including the use of a flowable fill or class D concrete.
  9. If additional repair procedures must be undertaken by the Contractor to prepare the existing surface to the Manufacturers recommended condition prior to lining, the Contractor shall coordinate the repair with the Inspector for approval. No additional payment will be made for additional surface preparation or repairs that are not shown on the plans. All materials used shall be compatible with the CIPP lining system product. All product data for all proposed products shall be submitted during the submittal process, prior to commencing work.

### 3.3 ACCEPTABLE APPLICATORS: NOT USED

### 3.4 EXAMINATION: NOT USED

### 3.5 SEALING ACTIVE LEAKS:

- A. The work consists of hand applying a dry quick-setting cementitious mix, or pre-liner, for heavy leaks, or chemical grout designed to instantly stop running water or seepage in all types of pipes. The contractor shall apply an approved CIPP-compatible quick-setting mortar or chemical grout in accordance with Manufacturer's recommendations.

### 3.6 BYPASS PUMPING:

- A. Contractor is responsible for monitoring local weather prior to scheduling work. The Contractor is responsible for any complications that arise from materials not curing due to surface runoff that may enter the system via manhole lids, inlets, infiltration or any other route. The City will not be responsible for any added costs due to such issues. Delays in contract time will not be acceptable due to rework caused by weather complications.

### 3.7 MATERIAL REMOVAL AND DISPOSAL:

- A. Sediment will be of variable consistency and water content that will require different handling processes and will require different tools and equipment for safe handling and removal. The Contractor shall be responsible for removing sediment regardless of consistency and water content.
- B. Under no circumstances shall any debris removed during these operations be dumped or spilled onto streets, ditches, storm drains, or sanitary sewers. All solids or semisolids resulting from the cleaning operations shall be removed from the site and disposed of by the Contractor in a legal and sanitary manner as approved by appropriate authorities at the Contractor's cost. All materials shall be removed from the site no less often than the end of each workday. Material may be allowed to de-water overnight in the collection boxes. Under no circumstances will the Contractor be allowed to accumulate debris, etc., on site of work beyond the stated time, except on totally enclosed containers and as acceptable to the City. Materials removed from the pipes and structures during cleaning operation shall be drained free of water. The Contractor shall dispose of this material as specified in the approved Disposal Plan.
- C. Contractor shall keep the haul route and work area(s) neat and clean and reasonably free of odors and shall bear responsibility for the cleanup of any spill which occurs during the transport of cleaning and surface preparation by-products and the cleanup of any such material which is authorized by or pursuant to this contract and in accordance with the applicable law and regulations. The Contractor shall immediately clean up any such spill or waste. If the Contractor fails to clean up such spill or waste immediately, the City of Newark shall have the right to clean up or arrange for its cleanup and shall charge the Contractor all costs, including administrative costs and overhead, incurred by the City of Newark in connection with such cleanup. The City of Newark shall also charge to the Contractor any costs incurred or penalties imposed on the City of Newark by regulatory agencies as a result of any spill dump or discard. Under no circumstances is this material to be discharged into the waterways or any place other than where authorized to do so by the appropriate authority.
- D. The general requirements for vehicles hauling such waste material are as follows: Transport vehicles must be of type(s) approved for this application by the political

jurisdictions involved. General requirements are that the vehicles are equipped and fitted with necessary seals or covers to prohibit material spillage or drainage, and that they are cleaned as often as is necessary to prevent deposit of material on roadways. Vehicles must be loaded within legal weight limits and operated safely within all traffic speed regulations.

- E. The routes used by the Contractor for the conveyance of this material on a regular basis shall be subject to approval by the governing authority having jurisdiction over such routes.

### 3.8 CONSTRUCTION METHODS:

- A. Prior to the installation of the liner, an installation plan must be submitted to and approved by the City of Newark. This plan shall be submitted by the Contractor and approved by the Manufacturer prior to approval by the Department. The plan shall include the following; the pipe liner material (tube and resin), tests and certifications of the material, liner design calculations stamped by a professional Engineer licensed in the state of Delaware, measurements of the host pipe, installer documentation, installation procedure, and associated drawings.
- B. The finished pipe liner shall be left extending beyond the end of the host pipe to create a mechanical lock to the abutting structure to assist holding the liner in place.
- C. CIPP installation shall be in accordance with ASTM F1216, ASTM F1743, or ASTM F2019 with the following modifications:
  - 1. Resin Impregnation - The quantity of resin used for tube impregnation shall be sufficient to fill the volume of air voids in the tube with additional allowances for polymerization shrinkage and the potential loss of resin during installation through cracks and irregularities in the original pipe wall, as applicable.
  - 2. Tube Insertion – The wet out tube shall be positioned in the pipeline using either inversion or a pull-in method as defined within relevant ASTM standards previously stipulated. If pulled into place, a power winch or its equivalent should be utilized and care should be exercised not to damage the tube as a result of pull-in friction. The tube should be pulled-in or inverted through an existing manhole or approved access point and fully extend to the next designated manhole or termination point
- D. Contractor shall follow manufacturer recommendations for monitoring temperatures during the cure cycle.
- E. Curing shall be accomplished by utilizing hot water under hydrostatic pressure, steam pressure, or ultra-violet light cured in accordance with the manufacturer's recommended cure schedule. A cool-down process shall be conducted that complies with the resin manufacturer's specification.

### 3.9 END OF SHIFT EQUIPMENT CLEAN UP PROCEDURES:

- A. All equipment used during the days/shifts operations shall be properly cleaned and stored.
- B. All hoses, fittings, pumps, mixers, spray head equipment, retraction equipment will be cleaned both inside and out.

### 3.10 FINAL INSPECTION:

- A. A visual inspection of the CIPP shall be in accordance with ASTM F1743, Section 8.6
- B. At the completion of a lining stage of the pipe, and once all repairs have been made and accepted, a video inspection DVD and log (1 copy of both) of the completed line segments shall be submitted to the City by the Contractor in a format acceptable to the City. This inspection shall be performed by a color video inspection system. The finished CIPP Liner shall be continuous over the entire length of all runs and be free of dry spots. No infiltration of groundwater shall be observed. All service entrances shall be accounted for and shall be unobstructed.

### 3.11 ACCEPTANCE:

- A. Acceptance of the CIPP lining system shall be based on inspection and testing results. Any thickness less than the thickness required with the allowable variance shall not be accepted for any reason.
- B. CIPP samples shall be for each installation. Pipe physical properties will be tested in accordance with ASTM F1216, ASTM F1743, or ASTM F2019 using either method proposed. The flexural properties must meet or exceed the values in this specification, Table 1 of ASTM F1216 or the values submitted to the Owner/engineer by the contractor for this project's CIPP wall design, whichever is greater.
- C. Wall thickness of samples shall be determined as described in paragraph 8.1.6 of ASTM F1743. The minimum wall thickness at any point shall not be less than 87½% of the submitted minimum design wall thickness.

### 3.12 WARRANTY INSPECTION:

- A. A Warranty Inspection shall be made by the Inspector and Applicator not less than 12 months after the establishment of Final Acceptance, but not more than 18 months afterwards. Any deficiencies in the finished coating shall be marked and repaired by the Applicator according to the procedures set forth herein.
- B. At the completion of the Warranty Inspection, and once all repairs have been made and accepted, a video inspection DVD and log (1 copy of both) of the completed line segments shall be submitted to the Engineer by the Contractor in a format acceptable to the City of Newark. This inspection shall be performed by a color video inspection system. All defects shall be repaired.

## SECTION 02 00 00

### SHOTCRETE STRUCTURAL LINING SYSTEM

#### PART 1 GENERAL

##### 1.1 SUMMARY:

This specification covers work, materials and equipment required for the preparation and installation dry-mix or wet-mix shotcrete liner providing a minimum 50-year design life for internal protection and structural rehabilitation. The protection lining works shall include all activities associated with the protection lining system, not limited to the following:

1. Design of approved shotcrete liner to the internal surface of the host pipe.
  2. Pre-construction inspection, cleaning, and surface preparation of host pipe prior to application of protection lining system.
  3. Installation of approved shotcrete liner to the entire internal surface of the host pipe, manhole to manhole, manhole to structure, or structure to structure. Partial liner installations, unless directed by the Owner, are not allowed.
  4. Quality Control Measures.
  5. Post-construction inspection, testing, and repairs.
  6. Warranty inspection, testing, and repairs.
- A. Work also includes preparatory work and operations necessary to mobilize and demobilize for the project. Work includes:
1. Mobilization and setting up operation on the project site with personnel, equipment, supplies, and accessory items.
  2. Scheduling details, coordination, and any other work and expense appropriate that is prior to start of work under other Contract pay items.
  3. Demobilization, of above items until the completion of project.
- B. Work also includes the following:
1. Removal and disposal of debris.

##### 1.2 REFERENCES: NOT USED

##### 1.3 DEFINITIONS:

- A. Shotcrete: Sand or other approved aggregate material and cement mixed and applied in dry or wet application, and pneumatically projected at high velocity onto surface to be rehabilitated.
- B. Dry-Mix Shotcrete: Shotcrete with most of the water added at nozzle.
- C. Wet-Mix Shotcrete: Shotcrete with ingredients, including mixing water, mixed before introduction into delivery hose.

#### 1.4 QUALITY ASSURANCE:

- A. Product Manufacturer: Company specializing in manufacturing shotcrete materials with minimum 5-years' experience. Company shall submit five (5) references for installation of proposed product within the last five (5) years.
- B. The Contractor and/or Subcontractor shall be able to demonstrate that they have successfully completed a minimum of 5,000 linear (LF) of shotcrete rehabilitation. The Contractor shall submit references meeting these requirements. The references shall include size/diameter of pipe, length of installation; size of bypass pumping required for performing the work, name and telephone number of the owner and date of installation.
- C. Single Source Responsibility: Use only products approved by shotcrete liner manufacturer and use only within recommended limits.
- D. Testing: Test reports prepared by a qualified independent laboratory indicating compliance with the following performance requirements:
  - 1. ACI 301, Specifications for Structural Concrete
  - 2. ACI 506.2, Specifications for Shotcrete
- E. All requested documented experience must be based on the experience of the "Company" and not on the experience of an individual within the organization.
- F. The Contractor shall submit a certified statement from the manufacturer that he/she is a certified and/or licensed installer of the liner.
- G. Personnel Experience: Foreman shall have a minimum of three (3) years of continuous experience as well as an ASA Shotcrete Nozzleman certification. Nozzle operators must all be ASA certified.
- H. The City of Newark reserves the right to approve or disapprove the Contractor, based on the submitted qualifications.

#### 1.5 COORDINATION WITH OTHERS:

- C. Contractor shall notify residents, businesses and all other authorities of project related roadway and traffic impacts. The work shall be coordinated with these authorities on a daily basis to avoid any conflict. Should the Contractor not perform notifications at least 48-hours in advance of their work, the City reserves the right to stop work until residents, businesses, etc have had 48-hours notice of proposed work.
- D. Potable water is available at no cost to the Contractor at the City of Newark's Municipal Maintenance Yard located at 406 Phillips Avenue, Newark DE 19711. Contractor shall not use any hydrants within the distribution system to obtain potable water. All water shall come from the Municipal Maintenance Yard.

## 1.6 SUBMITTALS:

- A. General: Provide all submittals, including the following in accordance with the requirements contained in the General Requirements.
- B. This section lists items that shall be **submitted at the time of bid**:
  - 1. Shotcrete material and design submittals: In order to compare bid proposals, the Contractor shall submit the specific shotcrete material proposed for the project with a material data sheet that shows it meets or exceeds all material properties in this specification.
  - 2. A preliminary design showing the proposed liner thickness for the project. Preliminary designs do not need to be sealed by a professional engineer in the state of Delaware. Once project is awarded, Contractor is responsible to submit signed and sealed final designs.
- C. All test reports, samples, minimum liner thickness calculations, and applicator qualifications shall be submitted to the City for review and approval prior to any field work taking place.
- D. Product Literature and Samples to be submitted prior to any field work:
  - 1. Submit representative samples and related product literature of materials being used, including names, material characteristics, and physical and structural properties, sources, and descriptions. Include required substrate preparation, on-site quality assurance recommendations and a list of all materials to be used.
  - 2. Submit manufacturer's recommendations for shipping, storage and handling of all components of the shotcrete lining materials. Manufacturer's recommended pressures, temperatures, and duration of curing shall also be submitted.
  - 3. Manufacturer's standard size cured sample showing the installed lining system to be expected in the finished Work. Show the full thickness, or a typical thickness when underlayment requirements will vary, of the system with all components in place. The shotcrete lining must be at full thickness. Samples submittals will be reviewed for floor, texture, and pattern only. Compliances with other requirements is the sole responsibility of the Contractor.
  - 4. Liner design sealed by a Professional Engineer licensed in the State of Delaware.
  - 5. Design mixes for each shotcrete mix.
  - 6. Details of fabricating, bending, and placing reinforcement. Include support and anchor details, number and location of splices, and special reinforcement required for openings through shotcrete structures.
- E. Health and Safety Plan (HASP) specific for all aspects of the cleaning operations and debris removal/disposal and coordination with the aforementioned required cleaning plans. Employee safety, HASP adequacy and regulatory compliance are the sole responsibility of the Contractor. The City will confirm that the Contractor's HASP exists, but neither will comment, approve or disapprove the plan.

- F. Before any field work by the Contactor, the Contractor shall submit the following to the City to review:
  - 1. Manufacturer-certified copies of all test reports on each product used, including ASTM test results indicating the product conforms to and is suitable for its intended use per these specifications material properties.
- G. Certificates: Submit certificates proving that personnel performing the work are qualified to the level required in these specifications. List personnel by name with capabilities, projects, and duties performed on those projects. Prove written certification of compliance with the ASTM standards cited in this specification.
- H. Detailed plan for weather monitoring during shotcrete application and, when applicable, traffic control methods and inventory of the equipment proposed for this operation.
- I. The Contractor shall submit the following information the same day as the installation:
  - 1. Daily Activity Logs and Field measurements as stated herein.
  - 2. Daily confined space entry form for each manned entry made. Contractor is responsible for confined space permitting.
- J. After cleaning and TV inspection by the Contractor of all proposed pipe and structures to be rehabilitated and before beginning lining any pipe or structure, the Contractor shall submit the following to the City for review:
  - 1. DVD and log (1 copy of both) of the Contractor's TV inspection of the pipe or structure prior to product application in a format acceptable to the City.
- K. After rehabilitation of the pipe or structure, the Contractor shall submit the following to the City of Newark for record purposes:
  - 1. DVD and log (1 copy of both) of the Contractor's TV inspection of the Completed Work in a format acceptable to the City.
  - 2. Test results of samples of shotcrete liner as specified in the contract documents.

#### 1.7 DELIVERY, STORAGE, AND HANDLING:

- A. Delivery: Deliver materials in original containers with seals unbroken and labels intact and free of moisture. Do not use materials that have been exposed to moisture or if there is visible damage to the packaging.
- B. Receipt Process: All materials must be inspected upon receipt and properly documented as to the amount of material and the identification of the material by batch numbers. Dates and times along with the shipping company delivering the material should be recorded for possible future reference.
- C. Storage: Contractor shall designate a specific space at the project site for storing and mixing materials. Protect this space and repair all damage resulting from use. Do not store kerosene nor gasoline in this space. Remove oily rags at the end of each day's work. Products are to be kept dry, protected from weather and stored under cover within the temperature ranges recommended by the manufacturer.

Products are to be stored and handled according to their MSDSs or appropriate classification. Damaged or unsuitable products shall be promptly removed from the job site and shall be replaced with suitable materials.

## 1.8 PROJECT CONDITIONS:

- A. Environmental Requirements: Contractor shall conform with all local, state and federal regulations including those set forth by OSHA and the EPA and any other applicable authorities. Confined space entry requirements shall be followed. Contractor is responsible for following all OSHA confined space regulations and for ensuring all workers are wearing the proper personal protective equipment (PPE) and monitoring equipment.
- B. Provide continuous ventilation and if necessary cooling and heating facilities to maintain surface and ambient temperatures before, during, and following application of finishes, within temperature range and for duration as directed by manufacturer.
- C. Protection: Provide sufficient shielding to fully protect adjacent finished work.
- D. Safety: Contractor shall consider the structure as a confined space. The OSHA Regulation Document, CFR 29, Part 1910.146 considers storm pipes confined spaces. Personnel must have the adequate training in confined space. Personnel shall follow all OSHA regulations in terms of training, equipment, monitoring, personal protective equipment (PPE), and all other requirements.
- E. Cold – Weather Shotcreting: Protect shotcrete work from physical damage or reduced strength caused by frost, freezing, or low temperatures according to ACI 306.1 and as follows:
  - 1. Discontinue shotcreting when ambient temperature is 40 deg. F and falling. Uniformly heat water and pre-packaged materials before mixing to obtain a shotcrete shooting temperature of not less than 50 deg. F and not more than 90 deg. F.
  - 2. Do not use frozen materials containing ice or snow.
  - 3. Do not place shotcrete on frozen surfaces or surfaces containing frozen materials.
  - 4. Do not use calcium chloride, salt, or other materials containing antifreeze agents.
- F. Hot-Weather Shotcreting: Mix, place, and protect shotcrete according to ACI 506R when hot weather conditions and high temperatures would seriously impair quality and strength of shotcrete, and as follows:
  - 1. Cool ingredients before mixing to maintain shotcrete temperature at time of placement below 100 deg. F for dry mix or 90 deg. F for wet mix.
  - 2. Reduce temperature of reinforcing steel and receiving surfaces below 100 deg. F before shotcreting.

## 1.9 CLEANING:

- A. It is the intent of this contract that the storm pipe, structures, and all other appurtenances be cleaned and inspected within the project limits as defined by these contract documents. The Contractor is responsible for all procedures of accessing and, cleaning as necessary to complete the work required prior to shotcrete lining.
- B. The Contract Drawings provide details showing the access points for cleaning the structure and pipes. It is the responsibility of the Contractor to include personnel on their team as necessary to successfully and safely conduct the work as shown on the contract drawings and to execute the planned work approach (means and methods).
- C. Cleaning procedures shall include the use of equipment adequate to clean and remove all debris that hinders CCTV and surface preparation prior to shotcrete lining. Debris may include, but is not limited to roots, trash, gravel, silt, clay, bottles, wood, rocks, metallic debris, cloth materials, leaves, organic material, rags, and other materials in the pipe and structures.
- D. The sediment and other settled materials have not been characterized in a laboratory. The Contractor shall anticipate that sediment and other settle materials shall be of variable consistency ranging from runny, quick-sand type material to firm, clay-like to solid materials with any of the aforementioned debris interspersed in the sediment.

## 1.10 DISPOSAL OF MATERIALS:

- A. All waste materials, including but not limited to extracted materials from the storm pipe and structures, excess construction materials, and other debris shall become the property of the Contractor. In all cases, the Contractor shall collect and transport all materials of all kinds removed from the storm pipe and structures. The Contractor shall dispose of all such materials in accordance with the approved disposal plan at no additional cost to the City. No additional payment will be made for separating materials as required by the approved disposal facility (i.e. separating trash from sediment) or disposing of materials separately.
- B. The Contractor shall prepare a Disposal Plan for review and approval by the City prior to performing any work that might generate waste materials. The plan shall include a complete description of the materials that are expected to be encountered, dewatering procedures and their proposed disposal site(s).
- C. The Contractor shall be responsible for obtaining all Federal, State and Local permits related to the disposal operations and the Contractor shall comply with all requirements of those permits.

## 1.11 QUALITY CONTROL:

- A. Daily Activity Logs:
  - 1. A Daily Activity Log will be filled out completely anytime a work crew is on site. This log includes listing the personnel present at the site, when they arrived and when they left the site.
  - 2. The operating conditions are also recorded. These measurements include the water addition rate taken at the meter tube, the retrieval speed of the retraction system and the pump motor speed recorded at the pump.

3. Any special conditions are to be noted in the daily log.
- B. Equipment Calibration Reports:
  1. Equipment calibration reports are to be maintained at all times for inspection by the City's staff.
- D. Final Inspection:
  1. Inspection of the lining products and materials may also be made by the City after delivery. The lining products and materials shall be subject to rejection at any time on account of failure to meet any of the Specification requirements, even though samples may have been accepted as satisfactory at the place of manufacture. Lining materials rejected after delivery shall be marked for identification and shall be removed from the job immediately.

#### 1.12 WARRANTY:

- A. Contractor shall warrant all work against defects in materials and workmanship for a period of two (2) years, unless otherwise noted, from the date of the Warranty Inspection. The Warranty Inspection shall occur at least twelve (12) months after the final acceptance of the project, but not more than 18 months afterwards. Contractor shall, within a reasonable time after receipt of written notice thereof (but not more than 120 calendar days), repair or replace defects in materials or workmanship which may have developed since the date of Final Acceptance, and any damage to other work caused by such defects or the repairing of same, at his or her own expense and without cost to the City of Newark.
- B. The Contractor shall also warrant the City of Newark so that the materials used on this contract, where covered by patents or license agreements, are furnished in accordance with such agreements and that the prices included herein cover all applicable royalties and fees in accordance with such license agreements. The contractor shall defend, indemnify and hold the City of Newark harmless from and against any and all costs, loss, damage or expense arising out of or in any way connected with any claim of infringement of patent, trademark or violation of license agreement.

## **PART 2 PRODUCTS**

### 2.1 EXISTING PRODUCTS:

- A. Existing pipe will consist of corrugated metal.

### 2.2 ACCEPTABLE MATERIALS:

- A. Cement:
  1. Portland conforming to ASTM C150, Type I/II.
- B. Aggregate:
  1. The Aggregate shall be naturally siliceous sand conforming to the requirements of ASTM C-33, unless otherwise designated.
  2. Aggregate shall not contain less than 3% nor more than 6% moisture.
  3. The combined gradation of coarse and fine aggregates shall conform to the

following unless otherwise designated:

Sieve Size (US Standard) Square Mesh	Percent by Weight Passing Individual Sieve
1 inch	-----
¾ inch	-----
½ inch	100
3/8 inch	95-100
No. 4	72-85
No. 8	52-73
No. 16	36-55
No. 30	20-38
No. 50	7-20
No. 100	2-12
No. 200	0-5

A. Water:

1. Only fresh, clean, potable water shall be used in mixing.

B. Admixtures:

1. Admixtures shall be subject to the approval of The City of Newark. Admixtures containing calcium chloride or triethanolamine shall not be used. Admixtures used in combination shall be physically and chemically compatible and shall be so certified by the manufacturer. Admixtures shall be products of a single manufacturer who shall provide, as necessary, assistance, and advice to The City of Newark on the proper use of admixtures. Use of admixtures shall be at Contractor's expense and no separate payment will be made.
  - a. Chemical admixtures shall conform to ASTM C-494.
  - b. Air entrained admixtures shall conform to ASTM C-260.
  - c. Fly ash and pozzolanic materials shall conform to ASTM C-618.
  - d. Accelerating admixtures shall develop quick set and high-early strength characteristics as follows:

Time of Initial Set	3 minutes maximum
Time of Final Set	12 minutes maximum
8 Hour Compressive Strength	600 psi minimum

2. Time of setting shall be determined by Contractor in accordance with ASTM C-

266, except that the accelerator shall be added to 50 grams of cement, together with the water to produce a water to cement ratio of 0.40, in varying percentages expected to be used in the actual shotcrete installation. The minimum possible time interval shall be used to attain the proper mixing without disturbing the initial set of the paste.

3. The compressive strength shall be determined by Contractor in accordance with ASTM C-109, except that the accelerator in varying percentages expected to be used in the shotcrete mix design shall be added to the mortar prepared with a water cement ratio of 0.40. In order to accomplish the molding of the specimen without disturbing the initial setting of the mortar, the intervals of time in the above specification are hereby waived.

4. The shotcrete mix shall include an antimicrobial additive to prevent the concrete from bacterial growth.

A. Form Materials:

1. Form facing panels that will provide continuous, straight, smooth, concrete surfaces. Furnish panels in largest practicable sizes to minimize number of joints.

B. Reinforcement:

1. Steel Reinforcement:

- a. Reinforcing steel shall meet the requirements of ASTM A-615, Grade 60 unless otherwise designated.
- b. Welded wire fabric or wire mesh shall conform to ASTM A-185. Unless otherwise specified, the wire mesh shall be 2 inches by 2 inches - 12/12 gauge galvanized welded wire fabric.
- c. Metal accessories, including all spacers, ties, fasteners, and other devices shall be provided for properly spacing, placing, and supporting the reinforcement.

2.3 SHOTCRETE CHARACTERIZATION TECHNIQUES: NOT USED

2.4 SHOTCRETE DESIGN:

A. Structural Requirements

1. Shotcrete design mix shall be for Corrugated Metal Pipe (CMP) storm culvert applications, and fully deteriorated pipe condition.
2. Shotcrete component materials shall be selected and proportioned so as to produce a minimum 28-day compressive strength of 5000 psi ( $f_c$ ) and a minimum 28-day flexural strength of 800 psi.
3. Shotcrete shall be composed of Portland cement, aggregate, water, and reinforcement where specified, proportioned so as to produce a concrete suitable for pneumatic application and meeting the specified strength requirements herein set forth.

- B. The Shotcrete lining system designed for the fully deteriorated condition shall be based on the following conditions:
1. Assume that the groundwater surface is at elevation provided in design table.
  2. Unit weight of soil = 125 pcf.
  3. Modulus of soil reaction,  $E's = 700$  psi.
  4. Automotive vehicle loading of HS-20 as defined in AASHTO-SSHB, including impact factor shall be applied to all sites in the vicinity of roadways and vehicle storage or maintenance facilities shown on the Contract Drawings.
  5. Railroad loading of Cooper E80, as defined in AASHTO-SSHB, including impact factor, shall be applied at all sites in the vicinity of railroads shown on the Contract Drawings.
  6. Building live and dead loads shall be assumed to be 5,000 pounds per square foot (psf) on a 6 feet wide continuous footing within the direct influence of the culvert being rehabilitated at all sites impacted by buildings shown on the Contract Drawings.
  7. Maximum internal pressure head shall be 25 feet.
  8. Short-term during grouting:
    - a. Design Safety Factor for bending stresses shall not be less than 2.0
    - b. The shotcrete lining (including any internal bracing system, if used) shall be capable of withstanding a minimum of three (3) to five (5) psi grout pressure or higher if required by the installation.
  9. Long-term check:
    - a. Design Safety Factor shall not be less than 2.0.
    - b. Maximum deflection shall be two percent (2%).

2.5 PHYSICAL PROPERTIES: NOT USED

2.6 SHOTCRETE LINER APPLICATION EQUIPMENT:

- A. Mixing Equipment: Capable of thoroughly mixing shotcrete materials in sufficient quantities to maintain continuous placement.
- B. Dry-Mix Delivery Equipment: Capable of discharging aggregate-cement mixture into delivery hose under close control and maintaining continuous stream of uniformly mixed materials at required velocity to discharge nozzle. Equip discharge nozzle with manually operated water-injection system for directing even distribution of water to aggregate-cement mixture.
1. Provide uniform, steady supply of clean, compressed air to maintain constant nozzle velocity while simultaneously operating blow pipe for cleaning away rebound.
  2. Provide water supply with uniform pressure at discharge nozzle to ensure uniform mixing with aggregate-cement mix. Provide water pump to

system if line water pressure is inadequate.

- C. Wet-Mix Delivery Equipment: Capable of discharging aggregate-cement-water mixture accurately, uniformly, and continuously.

## 2.7 EQUIPMENT MAINTENANCE:

- A. All equipment shall be clean and in good working condition.
- B. Maintenance and service shall be performed on the equipment to Manufacturer's standards.

## **PART 3 EXECUTION**

### 3.1 PRE-CONSTRUCTION INSPECTIONS:

- A. Prior to lining, the Contractor's experienced personnel trained in the inspection of pipes shall clean and CCTV inspect the pipe, in accordance with the Contract Documents, accurately measure the existing pipes, and verify that host pipe dimensions are as per the plans to verify the requirement of the liner installation. Notify the City if conditions exist which will impact the installation. If the CCTV inspection shows an obstruction that will interfere with the proper liner installation, the Contractor shall remove the obstruction of defect prior to initiating lining. Debris, sediment, rocks, and trash are not considered obstructions and should be removed via cleaning, as required in these specifications.

### 3.2 SURFACE PREPARATION AND PRE-LINING REPAIRS:

- A. The floor and interior walls of the pipe shall be thoroughly cleaned and made free of all foreign materials including dirt, grit, roots, grease, sludge, rocks, trash, and all debris or material that may be attached to the wall or bottom of the pipe.
  - 1. High pressure water blasting with a minimum of 3,500 psi shall be used to clean and free all foreign material within the pipe.
  - 2. When grease and oil are present within the pipe, water may be heated to 200° F or an approved detergent shall be used integrally with the high-pressure cleaning water.
  - 3. All materials resulting from the cleaning of the pipe or structure shall be removed prior to application of the shotcrete material and properly disposed of. Cleaning, removing, and disposal of debris from pipes or structures, as shown on the plans, is considered incidental to shotcrete lining.
  - 4. Cleaning equipment used shall include, but shall not be limited to, rodding machines, dragging machines, and high velocity pressure washers as best suited for the particular task. Only equipment designed for cleaning of large diameter lines may be used.
  - 5. Dragging machine shall include appurtenances such as scrappers, squeegees, buckets, and porcupines. Selection of any equipment shall be based on field conditions such as terrain, access to manholes, structures, type of debris, size of pipe, and the conditions of lines at the time the work commences.

6. The cleaning equipment shall be capable of removing dirt, rocks, sand, stones, trash, mud, wood, bricks, and other materials and obstructions from the storm pipes and structures.
7. Backup equipment shall be available and capable of being delivered to the site within 24 hours.
8. The newly prepared surface shall be thoroughly moistened with water prior to application of shotcrete. In no instance shall shotcrete be applied in an area where there is free running water.

### 3.3 ACCEPTABLE APPLICATORS: NOT USED

### 3.4 EXAMINATION: NOT USED

### 3.5 SEALING ACTIVE LEAKS:

- A. The work consists of hand applying a dry quick-setting cementitious mix or, for heavy leaks, chemical grout designed to instantly stop running water or seepage in all types of pipes. The contractor shall apply an approved shotcrete-compatible quick-setting mortar or chemical grout in accordance with Manufacturer's recommendations.

### 3.6 FORMS:

- A. Design, erect, support, brace, and maintain forms, according to ACI 301, to support shotcrete and construction loads and to facilitate shotcreting. Construct forms so shotcrete members and structures are secured to prevent excessive vibration or deflection during shotcreting.
  1. Fabricate forms to be readily removable without impact, shock, or damage to shotcrete surfaces and adjacent materials.
  2. Construct forms to required sizes, shapes, lines, and dimensions using ground wires and depth gages to obtain accurate alignment, location, and grades in finished structures. Construct forms to prevent leakage but permit escape of air and rebound during shotcreting. Provide for openings, offsets, blocking, screeds, anchorages, inserts, and other features required in the Work.
- B. Form openings, chases, recesses, bulkheads, keyways, and screeds in formwork. Determine sizes and locations from trades providing such items. Accurately place and securely support items built into forms.

### 3.7 STEEL REINFORCEMENT:

- A. Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, and other materials that weaken shotcrete bonding.
- C. Securely embed reinforcing anchors into existing substrates, located as required.
- D. Accurately position, support, and rigidly secure reinforcement against displacement by formwork, construction, or shotcreting. Locate and support reinforcement by metal chairs, runners, bolsters, spacers, and hangers, as required.
- E. Place reinforcement to obtain minimum coverage for shotcrete protection. Arrange,

space, and securely tie bars and bar supports to hold reinforcement in position during shotcreting. Set wire ties with ends directed into shotcrete, not toward exposed shotcrete surfaces.

- F. Install welded wire fabric in lengths as long as practicable. Lap adjoining pieces at least one full mesh and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction.

### 3.8 APPLICATION:

- A. Apply temporary protective coverings and protect adjacent surfaces against deposit of rebound and overspray or impact from nozzle stream.
- B. Moisten substrate immediately before placing shotcrete.
  - 1. Moisten wood forms immediately before placing shotcrete where form coatings are not used.
- C. Apply shotcrete according to ACI 506.2.
- D. Apply dry-mix shotcrete materials within 45 minutes after pre-dampening and wet mix shotcrete materials within 90 minutes after batching.
- E. Deposit shotcrete continuously in multiple passes, to required thickness, without cold joints and laminations developing. Place shotcrete with nozzle held perpendicular to receiving surface. Begin shotcreting in corners and recesses.
  - 1. Remove and dispose of rebound and overspray materials during shotcreting to maintain clean surfaces and to prevent rebound entrapment.
- F. Maintain reinforcement in position during shotcreting. Place shotcrete to completely encase reinforcement and other embedded items. Maintain steel reinforcement free of overspray and prevent buildup against front face during shotcreting.
- G. Do not place subsequent lifts until previous lift of shotcrete is capable of supporting new shotcrete.
- H. Do not permit shotcrete to sag, slough, or dislodge.
- I. Remove hardened overspray, rebound, and laitance from shotcrete surfaces to receive additional layers of shotcrete; dampen surfaces before shotcreting.
- J. Do not disturb shotcrete surfaces before beginning finishing operations.
- K. Remove ground wires or other alignment control devices after shotcrete placement.
- L. Installation Tolerances: Place shotcrete without exceeding installation tolerances permitted by ACI 117R, increased by a factor of 2.

### 3.9 JOINTS:

- A. Construction joints or day's work joints shall be sloped off to a thin, clean, regular edge preferably at a 45-degree slope. Before placing the adjoining work, the slope portion of adjacent shotcrete shall be thoroughly cleaned as necessary, then moistened and scoured with an air jet.

### 3.10 SURFACE FINISH:

- A. Contractor shall bring the shotcrete to an even plane and well-formed corners.
- B. After the shotcrete has been placed to the depth required, the surface shall be checked with a straightedge or template. Low spots shall be brought up to grade by placing additional shotcrete.
- C. The entire surface shall then receive a brush finish parallel to the direction of flow.

### 3.11 CURING:

- A. Protect freshly placed shotcrete from premature drying and excessive cold or hot temperatures.
- B. Start initial curing as soon as free water has disappeared from shotcrete surface after placing and finishing.
- C. Cure shotcrete by one of the following methods:
  - 1. Moisture Curing: Keep surfaces continuously moist for at least seven days with water, continuous water-fog spray, water-saturated absorptive covers, or moisture-retaining covers. Lap and seal sides and ends of covers.
  - 2. Curing Compound: The curing compound should follow ASTM C309. Apply curing compound uniformly in continuous operation by power spray according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period. Apply curing compound to natural or gun-finished shotcrete at rate of 1 gal./100 sq. ft.
- D. Cure formed shotcrete surfaces by moist curing with forms in place for full curing period or until forms are removed. If forms are removed, continue curing by methods specified above, as applicable.

### 3.12 FORM REMOVAL:

- A. Forms not supporting weight of shotcrete may be removed after curing at not less than 50 deg. F for 24 consecutive hours after gunning, provided shotcrete is hard enough not to be damaged by form-removal operations and provided curing and protecting operations are maintained.
  - 1. Leave forms supporting weight of shotcrete in place until shotcrete has attained design compressive strength. Determine compressive strength of in-place shotcrete by testing representative field-cured specimens of shotcrete.
  - 2. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.
- B. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form facing materials are unacceptable for exposed surfaces. Apply new form coating compound as specified for new formwork.

### 3.13 REPAIRS:

- A. Remove and replace shotcrete that is delaminated or exhibits laminations, voids, or sand/rock pockets exceeding limits for specified core grade of shotcrete.
  - 1. Remove unsound or loose materials and contaminants that may inhibit bond of shotcrete repairs. Chip or scarify areas to be repaired to extent necessary to provide sound substrate. Cut edges square and 1/2 inch deep at perimeter of work, tapering remaining shoulder at 1:1 slope into cavity to eliminate square shoulders. Dampen surfaces and apply new shotcrete.
- B. Repair core holes from in-place testing according to repair provisions in ACI 301 and match adjacent finish, texture, and color.

### 3.14 TESTING:

- A. The testing laboratory shall be independent of the Owner, Engineer and Contractor; the testing laboratory, in addition to meeting requirements of ASTM C-1077 and ASTM E-329, must be an approved laboratory competent to perform concrete physical testing. All tests must be performed in strict accordance with the applicable ASTM standard.
- B. Within 24 hours of results of tests, copies of the results shall be submitted to the Architect, Contractor and the supplier if applicable.
- C. Shotcrete Testing: Wet shotcrete test cylinders (3"x6") shall be cast prior to pumping. Dry shotcrete test panels (16"x16"x6") shall be made and then 3" cores should be taken from the panel. Six cylinders or six cores shall be prepared for every 12 cubic yards of shotcrete placed and tested for air content (ASTM C 173 or ASTM C 231) and compressive strength (ACI 506.2 and ASTM C 42).
- D. Shotcrete Temperature: ASTM C 1064; 1 test hourly when air temperature is 40 deg. F and below and when 80 deg. F and above, and 1 test for each set of compressive-strength specimens.
- E. In-Place Shotcrete: If the cylinders or cores taken previously do not meet minimum testing requirements, in-place coring and testing will be necessary. Take a set of 6 unreinforced cores for each mix and for each workday or for every 12 cubic yards of shotcrete placed; whichever is less. Test cores for compressive strength according to ACI 506.2 and ASTM C 42. Do not cut steel reinforcement.
- F. Strength of shotcrete will be considered satisfactory when mean compressive strength of each set of 3 unreinforced cores equals or exceeds 85 percent of specified compressive strength, with no individual core less than 75 percent of specified compressive strength.

### 3.15 BYPASS PUMPING:

- A. Contractor is responsible for monitoring local weather prior to scheduling work. The Contractor is responsible for any complications that arise from materials not curing due to surface runoff that may enter the system via manhole lids, inlets, infiltration or any other route. The City will not be responsible for any added costs due to such issues. Delays in contract time will not be acceptable due to rework caused by weather complications.

1. If the cleaning process reveals that the pipe invert, crown or sidewalls are deteriorated, measures will be taken to provide a continuous slope to the pipe, including the use of a flowable fill or class D concrete.
2. If additional repair procedures must be undertaken by the Contractor to prepare the existing surface to the Manufacturers recommended condition prior to lining, the Contractor shall coordinate the repair with the Inspector for approval. No additional payment will be made for additional surface preparation or repairs that are not shown on the plans. All materials used shall be compatible with the shotcrete lining system product. All product data for all proposed products shall be submitted during the submittal process, prior to commencing work.

### 3.16 MATERIAL REMOVAL AND DISPOSAL:

- A. Sediment will be of variable consistency and water content that will require different handling processes and will require different tools and equipment for safe handling and removal. The Contractor shall be responsible for removing sediment regardless of consistency and water content.
- B. Under no circumstances shall any debris removed during these operations be dumped or spilled onto streets, ditches, storm drains, or sanitary sewers. All solids or semisolids resulting from the cleaning operations shall be removed from the site and disposed of by the Contractor in a legal and sanitary manner as approved by appropriate authorities at the Contractor's cost. All materials shall be removed from the site no less often than the end of each workday. Material may be allowed to de-water overnight in the collection boxes. Under no circumstances will the Contractor be allowed to accumulate debris, etc., on site of work beyond the stated time, except on totally enclosed containers and as acceptable to the City. Materials removed from the pipes and structures during cleaning operation shall be drained free of water. The Contractor shall dispose of this material as specified in the approved Disposal Plan.
- C. Contractor shall keep the haul route and work area(s) neat and clean and reasonably free of odors and shall bear responsibility for the cleanup of any spill which occurs during the transport of cleaning and surface preparation by-products and the cleanup of any such material which is authorized by or pursuant to this contract and in accordance with the applicable law and regulations. The Contractor shall immediately clean up any such spill or waste. If the Contractor fails to clean up such spill or waste immediately, the City of Newark shall have the right to clean up or arrange for its cleanup and shall charge the Contractor all costs, including administrative costs and overhead, incurred by the City of Newark in connection with such cleanup. The City of Newark shall also charge to the Contractor any costs incurred or penalties imposed on the City of Newark by regulatory agencies as a result of any spill dump or discard. Under no circumstances is this material to be discharged into the waterways or any place other than where authorized to do so by the appropriate authority.
- D. The general requirements for vehicles hauling such waste material are as follows: Transport vehicles must be of type(s) approved for this application by the political jurisdictions involved. General requirements are that the vehicles are equipped and fitted with necessary seals or covers to prohibit material spillage or drainage, and that

they are cleaned as often as is necessary to prevent deposit of material on roadways. Vehicles must be loaded within legal weight limits and operated safely within all traffic speed regulations.

- E. The routes used by the Contractor for the conveyance of this material on a regular basis shall be subject to approval by the governing authority having jurisdiction over such routes.

### 3.17 END OF SHIFT EQUIPMENT CLEAN UP PROCEDURES:

- A. All equipment used during the days/shifts operations shall be properly cleaned and stored.
- B. All hoses, fittings, pumps, mixers, spray head equipment, and retraction equipment will be cleaned both inside and out.

### 3.18 FINAL INSPECTION:

- A. At the completion of a lining stage of the pipe, and once all repairs have been made and accepted, a video inspection DVD and log (1 copy of both) of the completed line segments shall be submitted to the City by the Contractor in a format acceptable to the City. This inspection shall be performed by a color video inspection system. The finished shotcrete liner shall be continuous over the entire length of all runs and be free of dry spots. No infiltration of groundwater shall be observed. All service entrances shall be accounted for and shall be unobstructed.

### 3.19 ACCEPTANCE:

- A. When shotcrete lacks uniformity, exhibits segregation, honeycombing, or laminations, or contains dry patches, slugs, voids or sand pockets the Contractor shall remove and replace the defective shotcrete. The City of Newark's concurrence in the extent of removal and replacement is required.
- B. Prior to starting significant removal and replacement work the Contractor shall obtain The City of Newark's approval of their plan for making the repair. Such approval shall not be considered a waiver of The City of Newark's right to require complete removal of defective work if the completed repair does not produce shotcrete of the required quality and appearance.
- C. Repair work shall be performed only when The City of Newark is present.
- D. Repair shall be made with shotcrete conforming to this specification. When removal of defective shotcrete is required, reinforcement damaged or destroyed shall be replaced prior to replacement of the shotcrete. At the edges of removed sections the sound shotcrete shall be carefully trimmed to the extent required to expose sufficient reinforcement for effecting competent splices. The sound shotcrete at the edges of removed sections shall be trimmed to a slope of approximately 45 degrees with the surface of the work and shall be thoroughly moistened prior to placement of the new shotcrete.
- E. Portions of the work having thickness less than those specified may be repaired by the placement of additional layers of shotcrete, provided that such repair is expressly approved by The City of Newark.

- F. Surfaces of the work to which additional shotcrete is to be applied shall be prepared as required by this specification.
- G. Curing as specified in this specification shall be applied to repaired areas immediately after the repairs are completed.
- H. Contractor is responsible for providing internal inspection after the repairs are made, and submit video documentation to The City of Newark, in accordance with the Contract Documents.

### 3.20 WARRANTY INSPECTION:

- A. A Warranty Inspection shall be made by the Inspector and Applicator not less than 12 months after the establishment of Final Acceptance, but not more than 18 months afterwards. Any deficiencies in the finished coating shall be marked and repaired by the Applicator according to the procedures set forth herein.
- B. At the completion of the Warranty Inspection, and once all repairs have been made and accepted, a video inspection DVD and log (1 copy of both) of the completed line segments shall be submitted to the Engineer by the Contractor in a format acceptable to the City of Newark. This inspection shall be performed by a color video inspection system. All defects shall be repaired.

## SECTION 03 00 00

### GEOPOLYMER STRUCTURAL LINING SYSTEM

#### PART 1 GENERAL

##### 1.1 SUMMARY:

- A. This specification covers work, materials and equipment required for the preparation and installation of a Geopolymer Lining System providing a minimum 50-year design life for internal protection and structural rehabilitation. This is accomplished by using an approved structural, monolithic spray-application of a high-build, geopolymer liner system with corrosion protection. The protection lining works shall include all activities associated with the protection lining system, not limited to the following:
  - 1. Design of approved continuous protection liners to the internal surface of the host pipe.
  - 2. Pre-construction inspection, cleaning, and surface preparation of host pipe prior to application of protection lining system.
  - 3. Installation of approved continuous protection liners to the entire internal surface of the host pipe, manhole to manhole, manhole to structure, or structure to structure. Partial liner installations, unless directed by the Owner, are not allowed.
  - 4. Quality Control Measures.
  - 5. Post-construction inspection, testing, and repairs.
  - 6. Warranty inspection, testing, and repairs.
- B. Work also includes preparatory work and operations necessary to mobilize and demobilize for the project. Work includes:
  - 1. Mobilization and setting up operation on the project site with personnel, equipment, supplies, and accessory items.
  - 2. Scheduling details, coordination, and any other work and expense appropriate that is prior to start of work under other Contract pay items.
  - 3. Demobilization, of above items until the completion of project.
- C. Work also includes the following:
  - 1. Removal and disposal of debris.

##### 1.2 REFERENCES:

- A. Applicable ASTM and ACI Standards and Specifications  
Unless revised herein, the Contractor shall follow the latest revision of the practices and standards of the following American Society for Testing and Materials (ASTM) Standards, and the American Concrete Institute (ACI) Standards, which are made part of this specification:

1. American Society for Testing and Materials (ASTM):
  - a. ASTM C 33 – Standard Specification for Concrete Aggregates
  - b. ASTM C 39 – Standard Test Method for Compressive Strength for Cylindrical Concrete Specimens
  - c. ASTM C 42 – Standard Test Method For Obtaining And Testing Drilled Cores And Sawed Beams Of Concrete
  - d. ASTM C 78 – Standard Test Method For Flexural Strength Of Concrete (Using Simple Beam With Third-Point Loading)
  - e. ASTM C 109 – Compressive Strength Hydraulic Cement Mortars
  - f. ASTM C 138 / C 642 – Standard Test Method For Density
  - g. ASTM C 172 – Standard Practice for Sampling Freshly Mixed Concrete
  - h. ASTM C 266 – Standard Test Method For Time Of Setting Of Hydraulic-Cement Paste By Gillmore Needles
  - i. ASTM C 267 – Chemical Resistance Of Mortars, Grouts, And Monolithic Surfacing And Polymer Concretes
  - j. ASTM C 293 / C 348 – Flexural Strength Of Concrete
  - k. ASTM C 469 – Static Modulus Of Elasticity & Poisson’s Ratio Of Concrete Compression
  - l. ASTM C 496 – Splitting Tensile Strength Of Cylindrical Concrete Specimens
  - m. ASTM C 666 – Standard Test Method for Splitting Tensile Strength or Cylindrical Concrete Specimens
  - n. ASTM C 801 – Standard Test Method for Time of Setting of Hydraulic Cement Mortar by Modified Vicat Needle
  - o. ASTM C 882 – Bond Strength Of Epoxy-Resin Systems Used With Concrete By Slant Shear
  - p. ASTM C 1090 – Standard Test Method for measuring Changes in Height of Cylindrical Specimens of Hydraulic-Cement Grout
  - q. ASTM C 1138 – Standard Test Method For Abrasion Resistance Of Concrete By Sandblasting
  - r. ASTM C 1140-03a – Preparing And Testing Specimens From Shotcrete Test Panels
  - s. ASTM C 1202 – Standard Test Method For Electrical Indication Of Concrete’s Ability To Resist Chloride Ion Penetration
  - t. ASTM E 329 – Standard Specification For Agencies Engaged In Construction Inspection, Testing, Or Special Inspection

- u. ASTM F 2414 – Practice For Sealing Sewer Manhole Using Chemical Grouting
- 2. American Concrete Institute (ACI)
  - a. ACI 305R – Hot Weather Concreting
  - b. ACI 306R – Cold Weather Concreting

### 1.3 DEFINITIONS:

- A. Geopolymer: A high strength and ultra-low porosity material formed by alkali activation of aluminosilicate powder (e.g. typically materials with high percentages of silica and alumina).
- B. Rebound: Aggregate and cement paste, which ricochets off the surface during the application of shotcrete due to collision with the surface, reinforcement, or with the aggregate particles themselves.
- C. Cement: Cement, unless otherwise specified, includes Portland Cement, Geopolymer Cement, and Geopolymer Mortar.
- D. Fiber Reinforced Mortar: Any Cement Mortar reinforced with fibers to give the mortar higher strength or performance characteristics.
- E. Flowable Fill: Flowable fill shall be a controlled low-strength material consisting of fluid mixture of cement, fly ash, aggregate, water and with admixtures as necessary to provide workable properties.
- F. Abandonment: Abandonment of existing non-functional infrastructure(s) includes but not be limited to pipelines, manholes, concrete or masonry structures, laterals, connecting pipes, as shown on the Contract Drawings.

### 1.4 QUALITY ASSURANCE:

- A. Product Manufacturer: Company specializing in manufacturing quality Geopolymer liner products with minimum 5-years' experience. Company shall submit five (5) references for installation of proposed product within the last five (5) years.
- B. Applicator: Company specializing in Geopolymer liner products shall be pre-approved in the application of spray on lining systems. Applicator shall initiate and enforce quality control procedures consistent with applicable ASTM, ACI, and SSPC (Society for Protective Coatings) standards and the Geopolymer liner Manufacturer's recommendations. The Contractor and/or Subcontractor shall be able to demonstrate that they have successfully completed a minimum of 5,000 linear (LF) of spray on mortar lining rehabilitation. The Contractor shall submit references meeting these requirements. The references shall include size/diameter of pipe, length of installation; size of bypass pumping required for performing the work, name and telephone number of the owner and date of installation.
- C. Single Source Responsibility: Use only products approved by Geopolymer liner Manufacturer and use only within recommended limits.
- D. Testing: Structural rehabilitation products submitted for approval shall provide third party test results supporting the structural performance of the product and such

data shall be satisfactory to the City of Newark. No product will be approved without independent third-party testing verification.

- E. All requested documented experience must be based on the experience of the "Company" and not on the experience of an individual within the organization.
- F. The Contractor shall submit a certified statement from the manufacturer that he/she is a certified and/or licensed installer of the liner.
- G. Personnel Experience: Foreman shall have a minimum of three (3) years of continuous experience including 1000 hours as a spin cast machine operator and 500 hours as a nozzle operator. Nozzle operators shall have a minimum of 500 hours experience as a nozzle operator for construction within sewer and stormwater systems.
- H. The City of Newark reserves the right to approve or disapprove the Contractor, based on the submitted qualifications.

#### 1.5 COORDINATION WITH OTHERS:

- C. Contractor shall notify residents, businesses and all other authorities of project related roadway and traffic impacts. The work shall be coordinated with these authorities on a daily basis to avoid any conflict. Should the Contractor not perform notifications at least 48-hours in advance of their work, the City reserves the right to stop work until residents, businesses, etc have had 48-hours notice of proposed work.
- D. Potable water is available at no cost to the Contractor at the City of Newark's Municipal Maintenance Yard located at 406 Phillips Avenue, Newark DE 19711. Contractor shall not use any hydrants within the distribution system to obtain potable water. All water shall come from the Municipal Maintenance Yard.

#### 1.6 SUBMITTALS:

- A. General: Provide all submittals, including the following in accordance with the requirements contained in the General Requirements.
- B. This section lists items that shall be **submitted at the time of bid**:
  - 1. Geopolymer material and design submittals: In order to compare bid proposals, the Contractor shall submit the specific geopolymer material proposed for the project with a material data sheet that shows it meets or exceeds all material properties in this specification.
  - 2. Third party XRF testing in accordance with Section 2.3A. showing the geopolymer meets the properties specified.
  - 3. A preliminary design showing the proposed liner thickness for the project. Preliminary designs do not need to be sealed by a professional engineer in the state of Delaware. Once project is awarded, Contractor is responsible to submit signed and sealed final designs.

- C. All test reports, samples, minimum liner thickness calculations, and applicator qualifications shall be submitted to the City for review and approval prior to any field work taking place.
- D. Product Literature and Samples to be submitted prior to any field work:
  - 1. Submit representative samples and related product literature of materials being used, including names, material characteristics, and physical and structural properties, sources, and descriptions. Include required substrate preparation, on-site quality assurance recommendations and a list of all materials to be used.
  - 2. Submit manufacturer's recommendations for shipping, storage and handling of all components of the geopolymer lining materials. Manufacturer's recommended pressures, temperatures, and duration of curing shall also be submitted.
  - 3. Manufacturer's standard size cured sample showing the installed lining system to be expected in the finished Work. Show the full thickness, or a typical thickness when underlayment requirements will vary, of the system with all components in place. The geopolymer lining must be at full thickness. Samples submittals will be reviewed for floor, texture, and pattern only. Compliances with other requirements is the sole responsibility of the Contractor.
  - 4. Liner design sealed by a Professional Engineer licensed in the State of Delaware.
  - 5. Contractor shall submit literature for project materials including, but not limited to:
    - a. Geopolymer Liner
    - b. Flowable fill
    - c. Trash Rack
    - d. Concrete
    - e. Welded Wire Fabric
    - f. Wire Mesh
    - g. Carbon Fiber Wrap
    - h. Rebar
    - i. Pipe Supports
    - j. Hydraulic Cement
    - k. Chemical Grout
    - l. Manufactured Plug
    - m. List of all cleaning, inspection, safety, access plans, and traffic control equipment.
- E. Health and Safety Plan (HASP) specific for all aspects of the cleaning operations and debris removal/disposal and coordination with the aforementioned required cleaning plans. Employee safety, HASP adequacy and regulatory compliance are the sole

responsibility of the Contractor. The City will confirm that the Contractor's HASP exists, but neither will comment, approve or disapprove the plan.

- F. Before any field work by the Contractor, the Contractor shall submit the following to the City to review:
  - 1. Manufacturer-certified copies of all test reports on each product used, including ASTM test results indicating the product conforms to and is suitable for its intended use per these specifications material properties.
  - 2. Test reports shall be performed at the Contractor's expense and shall be carried out by an approved laboratory or by a reputable independent testing body meeting the requirements of ASTM E 329 and the requirements for an ACI Certified Field Testing Technician, Level I.
  - 3. Geopolymer manufacturer's product data and ins
- G. Certificates: Submit certificates proving that personnel performing the work are qualified to the level required in these specifications. List personnel by name with capabilities, projects, and duties performed on those projects. Prove written certification of compliance with the ASTM standards cited in this specification.
- H. Detailed plan for weather monitoring during geopolymer application and, when applicable, traffic control methods and inventory of the equipment proposed for this operation.
- I. The Contractor shall submit the following information the same day as the installation:
  - 1. Daily Activity Logs and Field measurements as stated herein.
  - 2. Daily confined space entry form for each manned entry made. Contractor is responsible for confined space permitting.
- J. After cleaning and TV inspection by the Contractor of all proposed pipe and structures to be rehabilitated and before beginning lining any pipe or structure, the Contractor shall submit the following to the City for review:
  - 1. DVD and log (1 copy of both) of the Contractor's TV inspection of the pipe or structure prior to product application in a format acceptable to the City.
- K. After rehabilitation of the pipe or structure, the Contractor shall submit the following to the City of Newark for record purposes:
  - 1. DVD and log (1 copy of both) of the Contractor's TV inspection of the Completed Work in a format acceptable to the City.
  - 2. Test results of samples of Geopolymer liner as specified in the contract documents.

#### 1.7 DELIVERY, STORAGE, AND HANDLING:

- A. Delivery: Deliver materials in original containers with seals unbroken and labels intact and free of moisture. Do not use materials that have been exposed to moisture or if there is visible damage to the packaging.

- B. Receipt Process: All materials must be inspected upon receipt and properly documented as to the amount of material and the identification of the material by batch numbers. Dates and times along with the shipping company delivering the material should be recorded for possible future reference.
- C. Storage: Contractor shall designate a specific space at the project site for storing and mixing materials. Protect this space and repair all damage resulting from use. Do not store kerosene nor gasoline in this space. Remove oily rags at the end of each day's work. Products are to be kept dry, protected from weather and stored under cover within the temperature ranges recommended by the manufacturer. Products are to be stored and handled according to their MSDSs or appropriate classification. Damaged or unsuitable products shall be promptly removed from the job site and shall be replaced with suitable materials.

#### 1.8 PROJECT CONDITIONS:

- A. Environmental Requirements: Applicator shall conform with all local, state and federal regulations including those set forth by OSHA and the EPA and any other applicable authorities. Confined space entry requirements shall be followed. Contractor is responsible for following all OSHA confined space regulations and for ensuring all workers are wearing the proper personal protective equipment (PPE) and monitoring equipment.
- B. Maintain the temperature inside the pipe at not less than 1.00° C (34° F) and no more than 38.00° C (100° F), or as otherwise directed by manufacturer, during application and finishing.
- C. Provide continuous ventilation and if necessary cooling and heating facilities to maintain surface and ambient temperatures before, during, and following application of finishes, within temperature range and for duration as directed by manufacturer.
- D. Protection: Provide sufficient shielding to fully protect adjacent finished work.
- E. Safety: Contractor shall consider the structure as a confined space. The OSHA Regulation Document, CFR 29, Part 1910.146 considers storm pipes confined spaces. Personnel must have the adequate training in confined space. Personnel shall follow all OSHA regulations in terms of training, equipment, monitoring, personal protective equipment (PPE), and all other requirements.
- F. Weather: Contractor shall take weather into consideration when scheduling work. Contractor is liable for any complications that arise from weather.

#### 1.9 CLEANING:

- A. It is the intent of this contract that the storm pipe, structures, and all other appurtenances be cleaned and inspected within the project limits as defined by these contract documents. The Contractor is responsible for all procedures of accessing and cleaning as necessary to complete the work required prior to geopolymer lining.
- B. The Contract Drawings provide details showing the access points for cleaning the structure and pipes. It is the responsibility of the Contractor to include personnel on their team as necessary to successfully and safely conduct the work as shown on the contract drawings and to execute the planned work approach (means and methods).

- C. Cleaning procedures shall include the use of equipment adequate to clean and remove all debris that hinders CCTV and surface preparation prior to geopolymer lining. Debris may include, but is not limited to roots, trash, gravel, silt, clay, bottles, wood, rocks, metallic debris, cloth materials, leaves, organic material, rags, and other materials in the pipe and structures.
- D. The sediment and other settled materials have not been characterized in a laboratory. The Contractor shall anticipate that sediment and other settle materials shall be of variable consistency ranging from runny, quick-sand type material to firm, clay-like to solid materials with any of the aforementioned debris interspersed in the sediment.

#### 1.10 DISPOSAL OF MATERIALS:

- A. All waste materials, including but not limited to extracted materials from the storm pipe and structures, excess construction materials, and other debris shall become the property of the Contractor. In all cases, the Contractor shall collect and transport all materials of all kinds removed from the storm pipe and structures. The Contractor shall dispose of all such materials in accordance with the approved disposal plan at no additional cost to the City. No additional payment will be made for separating materials as required by the approved disposal facility (i.e. separating trash from sediment) or disposing of materials separately.
- B. The Contractor shall prepare a Disposal Plan for review and approval by the City prior to performing any work that might generate waste materials. The plan shall include a complete description of the materials that are expected to be encountered, dewatering procedures and their proposed disposal site(s).
- C. The Contractor shall be responsible for obtaining all Federal, State and Local permits related to the disposal operations and the Contractor shall comply with all requirements of those permits.

#### 1.11 QUALITY CONTROL:

- A. Quality Control, Sampling and Testing:
  - 1. Testing Agency: Provide testing agency for material testing. Agency to meet requirements of ASTM E 329.
  - 2. Regulatory Requirements: Perform all work relating to geopolymer liner in accordance with ACI-350. The applicable code for construction lining shall conform to the latest edition of the ACI 350 Environmental Structures, Liner designs submitted for review shall bear the seal of a Professional Engineer licensed in the State of Delaware.
  - 3. Preconstruction Testing: Prepare specimens for examination on the first day of construction.
    - a. The proposed nozzle operators are to provide demonstration and proficiency in creating the test panels in the presence of the City of Newark.
    - b. Fabricate test specimens, in the presence of City of Newark, using

the equipment, materials, and mix proportions proposed for the project. Fabricate one specimen for each shooting position to be encountered (i.e. overhead, vertical and horizontal run sections). Job-moist cure the test specimens in the same manner as the work. Where practical, cure specimens in the storm pipe environment.

4. For compressive strength and flexural strength testing see section 3.12.
5. During application, Applicator shall regularly perform and record Geopolymer lining thickness readings with a method approved by manufacturer. Applicator shall submit all documentation on thickness readings to the Inspector on a daily basis when coating application occurs.

B. Daily Activity Logs:

1. A Daily Activity Log will be filled out completely anytime a work crew is on site. This log includes listing the personnel present at the site, when they arrived and when they left the site.
2. Important spray data includes the times material was applied and under which atmospheric conditions. The ambient air temperature, the dry powder temperature, the mixing water temperature, and the temperature inside the pipe are all recorded on the daily activity report.
3. The operating conditions are also recorded. These measurements include the water addition rate taken at the meter tube, the retrieval speed of the retraction system and the pump motor speed recorded at the pump.
4. Any special conditions are to be noted in the daily log.

C. Equipment Calibration Reports:

1. Equipment calibration reports are to be maintained at all times for inspection by the City's staff.

D. Final Inspection:

1. Inspection of the lining products and materials may also be made by the City after delivery. The lining products and materials shall be subject to rejection at any time on account of failure to meet any of the Specification requirements, even though samples may have been accepted as satisfactory at the place of manufacture. Lining materials rejected after delivery shall be marked for identification and shall be removed from the job immediately.

## 1.12 WARRANTY:

- A. Contractor shall warrant all work against defects in materials and workmanship for a period of two (2) years, unless otherwise noted, from the date of the Warranty Inspection. The Warranty Inspection shall occur at least twelve (12) months after the final acceptance of the project, but not more than 18 months afterwards. Contractor shall, within a reasonable time after receipt of written notice thereof (but not more than 120 calendar days), repair or replace defects in materials or workmanship which may have developed since the date of Final Acceptance, and any damage to other work

caused by such defects or the repairing of same, at his or her own expense and without cost to the City of Newark.

- B. The Contractor shall also warrant the City of Newark so that the materials used on this contract, where covered by patents or license agreements, are furnished in accordance with such agreements and that the prices included herein cover all applicable royalties and fees in accordance with such license agreements. The contractor shall defend, indemnify and hold the City of Newark harmless from and against any and all costs, loss, damage or expense arising out of or in any way connected with any claim of infringement of patent, trademark or violation of license agreement.

## **PART 2 PRODUCTS**

### **2.1 EXISTING PRODUCTS:**

- A. Existing pipe will consist of corrugated metal.

### **2.2 ACCEPTABLE MATERIALS:**

- A. Considered Geopolymer liner products shall be a micro-fiber reinforced ultra-dense Geopolymer. This material shall provide a high strength fiber reinforced mortar specifically designed for ease of mechanical pumping, spraying and spin casting. The Geopolymer liner shall not clog spinner heads or spray equipment.
- B. The Geopolymer liner shall be designed to produce a liner with improved compressive and flexural strength, high adhesion to damp surfaces, lower permeability and increased resistance to aggressive chemical attack as compared to Portland Cement based shotcrete systems.
- C. The fiber reinforced formula shall be engineered to improve hydraulic abrasion resistance, provide dimensional stability and protect against penetration by substances such as fats, oils, gases and chloride ions as compared to Portland Cement based shotcrete systems.
- D. Acceptable geopolymer materials include GeoSpray by Milliken Infrastructure Solutions, Inc, Geokrete by Quadex or approved equal.
- E. Additional materials including chemical grouts and hydraulic cements may be necessary to stop infiltration and create a proper surface profile for the geopolymer lining to be applied to. All materials must be compatible with the geopolymer lining material. Contractor shall submit the additional materials and a written letter from the manufacturer stating the material/s are compatible with the geopolymer system. This shall be submitted during the submittal process for approval prior to any application of materials.
- F. Additional materials including flowable fill or materials consisting of rapid setting cements, NSG aggregates, and various accelerating agents may be required to fill voids in the pipe and/or structures, including the invert. Filling voids in the pipe and/or structures, including the invert, may be required to create the proper surface profile prior to geopolymer lining. Contractor shall submit the additional materials and a written letter from the manufacturer stating the material/s are

compatible with the geopolymer system. This shall be submitted during the submittal process for approval prior to any application of materials.

G. Flowable Fill:

1. Cement: ASTM C150 Type I or II. Provide minimum cement content of 50 pounds per cubic yard.
2. Fly Ash: ASTM C618, Class C or F. Provide minimum fly ash content of 200 pounds per cubic yard.
3. Aggregate Gradation: 100 percent passing 3/8-inch sieve and not more than 10 percent passing No. 200 sieve.
4. Aggregate: Screened or crushed aggregate, pit or bank run fine gravels or sand.
5. Admixtures: Meeting ASTM C494 and ASTM C107 as needed to improve pumpability, to control time of set and to reduce bleeding.
6. Placement Characteristics: Self-leveling.
7. Shrinkage Characteristics: Non-Shrink.
8. Fluidifier: Meeting ASTM C937 as necessary to hold solid constituents in suspension. Add shrinkage compensator if necessary.
9. Unconfined Compression Strength: Minimum 75 psi and maximum 150 psi at 56 days.
10. Minimum Wet Density: 90 pounds per cubic foot.

H. Welded Wire Fabric

1. Welded wire fabric or wire mesh shall conform to ASTM A-185.
2. Wire mesh shall be 4x4-W1.4xW1.4 galvanized welded wire fabric.

## 2.3 GEOPOLYMER CHARACTERIZATION TECHNIQUES:

- A. A process to determine that a product is a geopolymer shall include oxide composition and phase composition.
1. Minimum 70% of raw material shall be Pozzolanic material composed of  $\text{SiO}_2$ ,  $\text{MgO}$ ,  $\text{Al}_2\text{O}_3$ , and  $\text{Fe}_2\text{O}_3$ .
  2. The geopolymer precursor shall be confirmed by X-ray fluorescence (XRF) analysis.

## 2.4 GEOPOLYMER PIPE DESIGN:

- H. The Contractor shall submit liner thickness calculations to the Engineer for review. Calculations shall substantiate sufficient liner thickness to achieve desired 50-year design life and meet the minimum design requirements listed in Table 1 below. These calculations must be verified, approved, and sealed by a registered Professional Engineer in the State of Delaware.
- I. The Contractor shall submit his or her proposal based upon the appropriate length, size, design life and host pipe/structure parameters designated in the Proposal Section.

- J. The final invert throughout the entire structure shall be in a manner that pooling, or ponding does not occur. If pooling or ponding is discovered in the Final inspection or Warranty inspection, the Contractor shall repair at no additional cost to the City. All pipes shall have a minimum thickness of 2”.
- K. Overall the hydraulic cross-section shall be maintained as large as possible. The geopolymer liner shall have a minimum of the full flow capacity of the original pipe before rehabilitation. Calculated capacities may be derived using a commonly accepted roughness coefficient for the existing pipe material taking into consideration its age and condition.

## 2.5 PHYSICAL PROPERTIES:

- A. The finished pipe must be such that once the Geopolymer liner sets, the total wall thickness will be homogeneous and monolithic.
- B. The Geopolymer liner material shall conform to the minimum requirements demonstrated in the following ASTM Standards as presented in Table 1 below:

TABLE 1

Physical Properties	ASTM Reference	Requirements
Compressive Strength	ASTM C 109	Min. 8,000 psi @ 28 days
Chemical Resistance, Sulfuric Acid PH 1.0	ASTM C 267	Max 2% mass loss @ 8 weeks
Flexural Strength	ASTM C 78	Min. 800 psi @ 28 days
Modulus of Elasticity	ASTM C 469	Min. 5,000,000 psi @ 28 days
Split Tensile Strength	ASTM C 496	Min. 800 psi @ 28 days
Shrinkage Test	ASTM C 596	Max + 0.03% @ 28 days Min 0.00% @ 28 days
Bond Strength to Concrete	ASTM C 882	Min. 1,700 psi @ 28 days
Density	ASTM C 138 / C 642	Dry 110 - 120 lb/ft <sup>3</sup> Wet 135 - 145 lb/ft <sup>3</sup>

## 2.6 GEOPOLYMER LINER APPLICATION EQUIPMENT:

- A. Manufacturer approved equipment shall be used in the application of the specified Geopolymer lining.
- B. Major equipment components consist of a generator, an air compressor, a high-pressure washer (3,500 psi minimum), a high shear mixer, a high output pump, a gyroscopic high-speed spin cast delivery assembly, an electronic retraction system capable of +/- 5% repeatability, and high-pressure hoses and couplings.
- C. Application equipment shall include a high shear mixer and high output swing tube pump. In addition, the application equipment will have safety sensors that monitor specific operation parameters. This system ensures proper water to material ratios and material consistencies.
- D. Application equipment shall have visible display for the rate of water addition. This will ensure water/material ratios are known and controlled. Water/material ratio must be maintained per Manufacturer’s recommendations.

- E. Application equipment shall measure the back pressure on the discharge side of the pump. The change in pressure will alert the operator to any potential changes in flow rates. Backpressures must not exceed the system providers recommendations at all times.
- F. Spinner head shall be attached to a gyroscopic mechanism to layer the materials. The gyroscopic mechanism can adjust the spinner head pattern and frequency. The multiple layering process allows more uniform application of the product and achieves higher thickness levels in a single pass.
- G. Retraction system shall be capable of pulling the sled assembly with no more than +/-5% tolerance. The tolerance shall be verified on a daily basis, prior to product application, and recorded in the daily log.
- H. Retraction system shall have a visible display that monitors the controlled rate of retraction. The rate of retraction and the volume of material discharged is necessary to calculate the thickness of the applied materials.
- I. The rate of retraction, material application volume, dry material usage and length of pipe covered shall be monitored and recorded on a daily basis. This is critical to measure the thickness of material applied.

## 2.7 EQUIPMENT MAINTENANCE:

- A. All equipment shall be clean and in good working condition.
- B. Maintenance and service shall be performed on the equipment to Manufacturer's standards.
- C. Inspect the dry material hopper in the mixer to ensure that there is no blockage or debris in the dry material feed point. Remove any debris prior to feeding dry powder.
- D. Inspect the pre-mix chamber to ensure it that there is no blockage or debris. Remove any debris prior to mixing.
- E. Inspect the mixing chamber to ensure there is no blockage on debris. Remove any debris or dry materials prior to application.
- F. Inspect the rotor/stator pump to ensure there is no debris or blockage in the pump. Remove any debris prior to application.
- G. Spare parts or extra equipment shall be kept on site to ensure rapid redeployment in the event of equipment failure.

## PART 3 EXECUTION

### 3.1 PRE-CONSTRUCTION INSPECTIONS:

- A. Prior to lining, the Contractor's experienced personnel trained in the inspection of pipes shall clean and CCTV inspect the pipe, in accordance with the Contract Documents, accurately measure the existing pipes, and verify that host pipe dimensions are as per the plans to verify the requirement of the liner installation. Notify the City if conditions exist which will impact the installation. If the CCTV inspection shows an obstruction that will interfere with the proper liner installation,

the Contractor shall remove the obstruction of defect prior to initiating lining. Debris, sediment, rocks, and trash are not considered obstructions and should be removed via cleaning, as required in these specifications.

### 3.2 SURFACE PREPARATION AND PRE-LINING REPAIRS:

- A. The floor and interior walls of the pipe shall be thoroughly cleaned and made free of all foreign materials including dirt, grit, roots, grease, sludge, rocks, trash, and all debris or material that may be attached to the wall or bottom of the pipe.
1. High pressure water blasting with a minimum of 3,500 psi shall be used to clean and free all foreign material within the pipe.
  2. When grease and oil are present within the pipe, water may be heated to 200° F or an approved detergent shall be used integrally with the high-pressure cleaning water.
  3. All materials resulting from the cleaning of the pipe or structure shall be removed prior to application of the Geopolymer material and properly disposed of. Cleaning, removing, and disposal of debris from pipes or structures, as shown on the plans, is considered incidental to geopolymer lining.
  4. Cleaning equipment used shall include, but shall not be limited to, rodding machines, dragging machines, and high velocity pressure washers as best suited for the particular task. Only equipment designed for cleaning of large diameter lines may be used.
  5. Dragging machine shall include appurtenances such as scrappers, squeegees, buckets, and porcupines. Selection of any equipment shall be based on field conditions such as terrain, access to manholes, structures, type of debris, size of pipe, and the conditions of lines at the time the work commences.
  6. The cleaning equipment shall be capable of removing dirt, rocks, sand, stones, trash, mud, wood, bricks, and other materials and obstructions from the storm pipes and structures.
  7. Backup equipment shall be available and capable of being delivered to the site within 24 hours.
  8. If the cleaning process reveals that the pipe invert, crown or sidewalls are deteriorated, measures will be taken to provide a continuous slope to the pipe, including the use of a flowable fill or class D concrete.
  9. If additional repair procedures must be undertaken by the Contractor to prepare the existing surface to the Manufacturers recommended condition prior to lining, the Contractor shall coordinate the repair with the Inspector for approval. No additional payment will be made for additional surface preparation or repairs that are not shown on the plans. All materials used shall be compatible with the geopolymer lining system product. All product data for all proposed products shall be submitted during the submittal process, prior to commencing work.

10. Steel reinforcement may be required prior to geopolymer lining. Metal accessories, including all spacers, ties, fasteners, and other devices shall be provided for properly spacing, placing, and supporting the reinforcement.
11. All incoming pipes shall be temporarily plugged, as to not allow overspray. Flow from these pipes do not need to be maintained, but the Contractor is responsible for preventing any overflows relating to plugging during the lining applications. Any bypass pumping used to prevent overflows is the Contractor's responsibility. No payment will be made for bypass pumping and the City is not responsible for any complications that arise from overflows or bypass pumping operations.

### 3.3 ACCEPTABLE APPLICATORS:

- A. Geopolymer liner must be applied by a Certified Applicator of the Geopolymer lining Manufacturer, as discussed further in Section 1.5, and according to Manufacturer specifications.
- B. Format and Submission of Process Control Sheets and Procedures Checklist:
  1. Process Control Sheet and Procedure Checklist for all work shall be prepared prior to commencement of the work. These sheets shall be used to ensure that the work is carried out and audited at multi-levels according to standard steps and procedures in the Process Control sheets and Procedures Checklist.
  2. A Process Control Sheet shall be prepared for each shift/application at each location. The Process Control Sheet shall contain the following information at minimum:
    - a. Location details, including chainage, upstream, downstream and all intermediate manhole/access chambers reference numbers, and the precise location of applied coating applications within the pipe system;
    - b. Condition of pipe surface and prevailing atmospheric conditions prior to application and during the application and curing process;
    - c. Material(s) used in the application;
    - d. Record of time/date of delivery of materials to application point;
    - e. Time of commencement and completion of the application;
    - f. Record details of:
      - 1) Quantity, weight of components, batch number of all coating materials used
      - 2) Mixing temperature and time

### 3.4 EXAMINATION:

- A. Applicator shall verify that surfaces and substrate conditions are ready to receive work as instructed by the product Manufacturer.

- B. Applicator shall examine surfaces scheduled to be finished prior to commencement of work. Report to City any condition that may potentially affect proper application.
- C. Appropriate actions shall be taken to comply with regulatory and other applicable agencies with regard to environment, health and safety.
- D. Any active flows shall be dammed, plugged or bypassed as required to ensure that the conveyed flow is maintained below the surfaces to be coated. Flows should be totally plugged and/or diverted when coating the invert and during required dry/cure periods. All extraneous flows into the pipe at or above the area coated shall be plugged and/or diverted until the Geopolymer liner has set per Manufacturer recommendations.
- E. Installation of the Geopolymer liner shall not commence until the host pipe has been properly cleaned and repaired in accordance with these specifications and Geopolymer liner Manufacturer recommendations. All internal debris, including but not limited to sediment, gravel, stones, trash, water, etc, shall be removed from the structure and disposed of via current environmental regulations. Prior to and during application, care should be taken to avoid exposure of direct sunlight or other intense heat source to the pipe being coated.

### 3.5 SEALING ACTIVE LEAKS:

- A. The work consists of hand applying a dry quick-setting cementitious mix or, for heavy leaks, chemical grout designed to instantly stop running water or seepage in all types of pipes. The contractor shall apply an approved geopolymer-compatible quick-setting mortar or chemical grout in accordance with Manufacturer's recommendations.

### 3.6 BYPASS PUMPING:

- A. Contractor is responsible for monitoring local weather prior to scheduling work. The Contractor is responsible for any complications that arise from materials not curing due to surface runoff that may enter the system via manhole lids, inlets, infiltration or any other route. The City will not be responsible for any added costs due to such issues. Delays in contract time will not be acceptable due to rework caused by weather complications.

### 3.7 MATERIAL REMOVAL AND DISPOSAL:

- A. Sediment will be of variable consistency and water content that will require different handling processes and will require different tools and equipment for safe handling and removal. The Contractor shall be responsible for removing sediment regardless of consistency and water content.
- B. Under no circumstances shall any debris removed during these operations be dumped or spilled onto streets, ditches, storm drains, or sanitary sewers. All solids or semisolids resulting from the cleaning operations shall be removed from the site and disposed of by the Contractor in a legal and sanitary manner as approved by appropriate authorities at the Contractor's cost. All materials shall be removed from the site no less often than the end of each workday. Material may be allowed to de-water overnight in the collection boxes. Under no circumstances will the Contractor be allowed to accumulate

debris, etc., on site of work beyond the stated time, except on totally enclosed containers and as acceptable to the City. Materials removed from the pipes and structures during cleaning operation shall be drained free of water. The Contractor shall dispose of this material as specified in the approved Disposal Plan.

- C. Contractor shall keep the haul route and work area(s) neat and clean and reasonably free of odors and shall bear responsibility for the cleanup of any spill which occurs during the transport of cleaning and surface preparation by-products and the cleanup of any such material which is authorized by or pursuant to this contract and in accordance with the applicable law and regulations. The Contractor shall immediately clean up any such spill or waste. If the Contractor fails to clean up such spill or waste immediately, the City of Newark shall have the right to clean up or arrange for its cleanup and shall charge the Contractor all costs, including administrative costs and overhead, incurred by the City of Newark in connection with such cleanup. The City of Newark shall also charge to the Contractor any costs incurred or penalties imposed on the City of Newark by regulatory agencies as a result of any spill dump or discard. Under no circumstances is this material to be discharged into the waterways or any place other than where authorized to do so by the appropriate authority.
- D. The general requirements for vehicles hauling such waste material are as follows: Transport vehicles must be of type(s) approved for this application by the political jurisdictions involved. General requirements are that the vehicles are equipped and fitted with necessary seals or covers to prohibit material spillage or drainage, and that they are cleaned as often as is necessary to prevent deposit of material on roadways. Vehicles must be loaded within legal weight limits and operated safely within all traffic speed regulations.
- E. The routes used by the Contractor for the conveyance of this material on a regular basis shall be subject to approval by the governing authority having jurisdiction over such routes.

### 3.8 MIXING OF THE GEOPOLYMER LINING MATERIAL:

- A. Contractor shall mix the Geopolymer material to the Manufacturer's recommended water/cement ratio. Precision metering of water in mixer is required to maintain the strict water to material ratio. The ability to closely adjust and monitor the addition of water through the use of a water meter is required.
- B. Mixing water temperatures must be determined before blending operations begin. The mixing water temperature must be recorded in the process control sheet at multiple times throughout the day during the installation process. Water temperatures should be maintained at all times to within the limits required by the system supplier or Manufacturer. The ability to provide mixing water at a consistent temperature is a critical aspect of the mixing and installation process.
- C. The lining material shall be mixed in a high shear mixer, or similar, to ensure thorough and uniform mix of water with the material prior to pumping.
- D. The mixing operations must be performed so that the minimum of dust is released into the surrounding environment.

- E. The batch style mixing, precise metering of water and pump rate eliminates wet/dry and thick/thin variations resulting in a uniform structure regardless of the pumping distance.
- F. Multiple spin cast nozzles should be onsite at all times to address any application issues or failure of the nozzle. Multiple nozzles may be required to produce the required depth or finish of the liner surface.

### 3.9 APPLICATION OF GEOPOLYMER LINING MATERIAL IN A PIPE:

- A. The necessary equipment and application methods to apply the liner materials shall be approved by the material Manufacturer prior to commencing lining. Lining may include spin-casting, hand spraying or hand troweling.
- B. The Geopolymer lining material delivery hose shall be coupled to a medium-velocity spray application nozzle which is capable of bidirectional operation.
- C. Pumping of the material shall commence and the material shall be spin cast onto the pipe surface. Hand spraying may be required at certain locations where spin casting is not possible. The Contractor is responsible for determining where each spray method is applicable and planning their methods accordingly. No additional payment will be made for alternate spraying methods.
- D. A gyroscopic head that has a speed adjustment for making multiple position changes per minute is required. The gyroscopic head allows the spin cast mechanism and the associated selected nozzle to make multiple passes on the pipe wall in a single pass of the sled assembly.
- E. Spraying of a pipe shall be performed by starting at the pipe end-project location (Lower level) and progressing towards the entrance of the pipe (Higher level).
- F. At the beginning of each application segment the retraction system should be calibrated.
- G. The measured rate observed and recorded must be within 5% of the expected speed and can be verified by this process.
- H. Geopolymer liner shall be applied to a specified uniform minimum thickness as instructed by the professional engineer registered in the State of Delaware. The uniform minimum thickness shall be based on meeting the required minimum design criteria, as listed in the specification. The applied minimum thickness will not deviate from the approved minimum design thickness submitted during the submittal process.
- I. The Geopolymer delivery hose shall be coupled to a gyroscopic applicator device. The gyroscopic applicator shall then be positioned within the center, or positioned higher inside the pipe, as required by the diameter of the pipe.
- J. As the material begins to be gyroscopically cast evenly around the interior of the cavity, the rotating applicator head shall produce a uniform material thickness to the repair surface.
- K. Controlled multiple passes shall then be made, if necessary, until the specified minimum finished thickness is attained. If the procedure is interrupted for any

reason, the operator shall arrest the longitudinal transition of the applicator head until flows are recommenced.

- L. Material thickness may be verified at any point with an approved depth gauge. If additional material is required at any level, the gyroscopic applicator head shall be placed at the location and application shall recommence until that area meets the required thickness.
- M. The lining material shall be applied to a damp surface, with no free water.
- N. The medium-velocity spray nozzle and the gyroscopic spin casting head may be used in conjunction to facilitate uniform application of the material to irregularities in the contour of the pipe walls.
- O. The City of Newark may specify certain pipe spans where the liner will be troweled following the spray application. Initial troweling shall be in an upward motion, to compress the material and solidify the pipe wall. This will not exceed 10% of the total linear feet in the project and will be done at no additional cost.
- P. The Contractor shall not place geopolymer if drying or stiffening of the mix takes place at any time prior to delivery to the nozzle.
- Q. The Contractor shall remove all overspray or rebound prior to final set.

#### 3.10 CURING OF THE GEOPOLYMER LINING MATERIAL:

- A. The Manufacturer's recommended cure schedule in the curing of Geopolymer liners must be strictly adhered to at all times. The Contractor must provide evidence of such adherence via the Process Control Sheet.
- B. Proper steps shall be taken to ensure the material is cured in a moist and moderate climate as directed by the Manufacturer. General underground conditions are usually adequate to meet this curing requirement. However, when situations of dry and/or hot conditions are present, the use of a wind barrier and fogging spray may be required.
- C. Refer to ACI 305R-99 for Hot Weather Concreting and ACI 306R-88 for Cold Weather Concreting.

#### 3.11 TERMINATION AND SEALING AT MANHOLES, INLETS AND SHAFTS:

- A. Termination of the Geopolymer liner at the end of a pipe, manhole or structure shall be completed by hand applying the liner to the outer surface of the pipe or into the interior of the manhole or structure. Similarly, laterals and pipe connections shall be completed by hand applying the liner to the outer surface of the connection to the pipe and smoothly tapering it into the lateral or connecting pipe.

#### 3.12 END OF SHIFT EQUIPMENT CLEAN UP PROCEDURES:

- A. All equipment used during the days/shifts operations shall be properly cleaned and stored.
- B. All hoses, fittings, pumps, mixers, spray head equipment, and retraction equipment will be cleaned both inside and out.

- C. All mixed Geopolymer materials shall be captured and disposed of properly.

### 3.13 FIELD MEASUREMENTS, SAMPLE AND TESTING:

- A. Contractor shall perform the following minimum tests or measurements:

1. Water addition rate, pump motor speed controller setting and pump distance.
2. Calculated geopolymer density.
3. Compressive strength.
4. Flexural strength per ASTM C78.
5. Humidity within the pipe.
6. Temperature:
  - a. Batch water.
  - b. Geopolymer dry powder before mixing.
  - c. Ambient temperature within the pipe.
  - d. Surface temperature of the pipe.
  - e. Ambient temperature at point of mixing.
  - f. Temperature of sampled material.

- B. Contractor shall be responsible for third party testing of the strength of the placed geopolymer according to the follow.3ing:

1. The geopolymer liner material shall be collected at the mixer, immediately before discharge into the pump, or at the end of the hose near the discharge point in accordance with ASTM C39 for cylinder sample or ASTM C 78 for beam samples. ACI grade 1 certified technician shall be used to obtain the sample.
2. A set of six (6) test cylinder specimens and nine (9) beam samples shall be taken at random by the ACI certified test laboratory for compressive strength test and flexural strength test. Test two cylinders and three beams at seven days, three cylinders and three beams at twenty-eight days, and, if the twenty-eight-day test does not meet the specification, one (1) cylinder and one (1) beam at 56 days or as directed.
3. ASTM C-31 shall be consulted prior to casting samples of Geopolymer mortar in the field. In addition to the procedures outlined in ASTM C-31, the following additional procedures, precautions or requirements shall be observed with respect to casting of Geopolymer mortar:
  - a. For compression testing use only 4-inch x 8-inch cylinders (or the metric equivalent).
  - b. For flexural strength testing use the dimensions shall be as specified by the manufacturer, but no smaller than 2" x 2" x 8" (or the metric equivalent).

- c. Molding: Mold specimens promptly on a level, ridged surface, free of vibration and other disturbance, at a place as near as practical to the location where they are to be stored.
  - d. Cylinders must be immediately capped with a water tight sealing cap provided with the molds. Geopolymer mortar is a high strength cementitious material and proper procedures for handling of high strength materials detailed in ASTM C-39/C-39M shall be followed. Specifically, a neoprene cap of a minimum 60 Duro should be used.
  - e. Beam molds should be tapped lightly with a rubber hammer for proper consolidation and screened of excess material. Tap or tamp each side of the beam mold to ensure there are no voids and all entrapped air has escaped.
  - f. Storage: Immediately after molding the specimens they should be stored for a period of 24 to 48 hours in a protected area where the samples will not be disturbed. The temperature range should be maintained, and a high low temperature meter should be used to record temperature.
  - g. Cylinder Curing: Geopolymer mortar requires final cure be in a 90% Relative Humidity room. SAMPLES MUST BE REMOVED AND DRIED FOR A MINIMUM OF 48 HOURS PRIOR TO TESTING (PREFERABLY WITH A DESECANT) FOR COMPRESSIVE SAMPLES.
  - h. Beam Curing: Beams should also be cured in at least a 90% Relative Humidity room. Cured beam samples must be tested fully wet therefore, BEAMS MUST BE SUBMERGED AT LEAST 48 HOURS PRIOR TO TESTING AND TESTED IMMEDIATELY UPON REMOVING FROM TANK. The top side of casting should be inserted such that it is rotated 90 degrees and is used as an edge side in the test as per guidelines.
  - i. Identify the area of the break (middle third or not). Measure weight of cured beam prior to testing and report.
- 4. The frequency of sample sets to be taken shall be determined as follows:
    - a. A minimum of one set of cylinder and beam samples shall be taken at the start of the project for the first fifty (50) linear feet of storm pipe section lined.
    - b. Then a minimum of one set of cylinder and bean samples shall be taken for every 12 cubic yards of installed material.
  - 5. Contractor shall mark the sample with the date that the liner was installed, the date that the sample was removed, and the location within the pipe segment.
  - 6. The City of Newark, at its own discretion, may request cores as necessary to ensure that the Work is provided in accordance with this specification. The Contractor shall remove a set of core from the installed liner at established intervals. The liner core sample shall be cored at three different clock positions, and average thicknesses measured shall be taken as the actual thickness of the

installed liner. Work for cores shall be directed by the City and incidental to the unit item for which the work is being constructed under.

7. Contractor shall plug all voids caused by coring operation by the use of material equal to the in-place geopolymer with workmanship that ensures continuity to the lining with respect to water tightness, strength, and appearance.

#### 3.14 FINAL INSPECTION:

- A. A final visual inspection shall be made by the Inspector and Applicator, periodically throughout the progression of construction prior to the completion of a lining stage. Any deficiencies in the finished coating shall be marked and repaired by Applicator according to the procedures set forth herein.
- B. At the completion of a lining stage of the pipe, and once all repairs have been made and accepted, a video inspection DVD and log (1 copy of both) of the completed line segments shall be submitted to the City by the Contractor in a format acceptable to the City. This inspection shall be performed by a color video inspection system. The finished Geopolymer shall be continuous over the entire length of all runs and be free of dry spots. No infiltration of groundwater shall be observed. All service entrances shall be accounted for and shall be unobstructed.

#### 3.15 ACCEPTANCE:

- A. Acceptance of the geopolymer liner shall be based on inspection and testing results. Any thickness less than the thickness required with the allowable variance shall not be accepted for any reason.
- B. The completed liner shall be smooth and free from honeycomb and areas of segregation.
- C. When geopolymer lacks uniformity, exhibits segregation, honeycombing, or laminations, or contains dry patches, slugs, voids or sand pockets the Contractor shall remove and replace the defective geopolymer. The City of Newark's concurrence in the extent of removal and replacement is required.
- D. If the compressive strength or flexural strength of installed liner is less than 90% of the specified values, the product is considered unacceptable. Contractor shall submit proposed method of repair or replacement for review and approved by the City of Newark. Repair work required to remedy non-conforming work shall be at no additional cost to the City of Newark.
- E. If it is determined that the geopolymer liner material did not match the submitted manufacturers claims, the product is considered unacceptable and non-conforming. Contractor shall submit proof that the geopolymer liner meets the requirements of the specification though the use of samples analyzed or retained at the manufacturing facility or submit a method of replacement of the liner for review and approval by the City of Newark. Work required to remedy non-confirming work shall be at no additional cost to the City of Newark.

#### 3.16 WARRANTY INSPECTION:

- A. A Warranty Inspection shall be made by the Inspector and Applicator not less than 12 months after the establishment of Final Acceptance, but not more than 18 months afterwards. Any deficiencies in the finished coating shall be marked and repaired by the Applicator according to the procedures set forth herein.
- B. At the completion of the Warranty Inspection, and once all repairs have been made and accepted, a video inspection DVD and log (1 copy of both) of the completed line segments shall be submitted to the Engineer by the Contractor in a format acceptable to the City of Newark. This inspection shall be performed by a color video inspection system. The finished Geopolymer shall be continuous over the entire length of all runs and be free of dry spots. No infiltration of groundwater shall be observed. All service entrances shall be accounted for and shall be unobstructed. All defects shall be repaired.

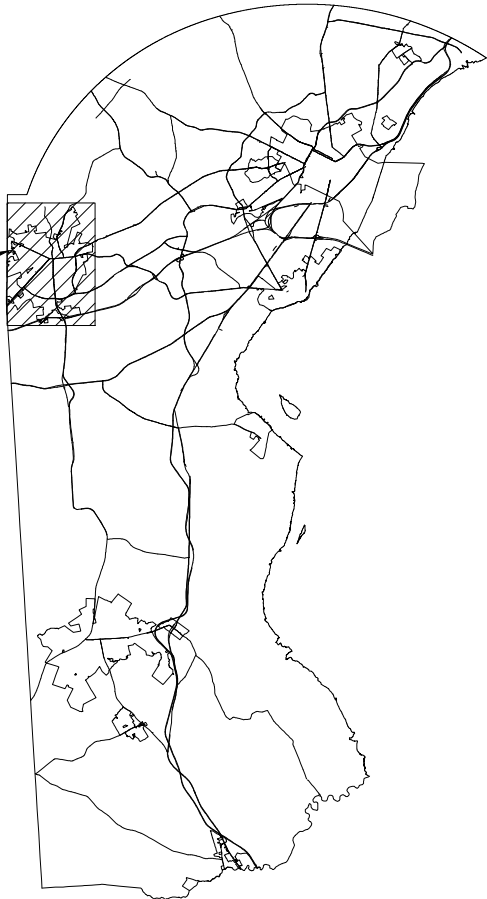
CITY OF NEWARK  
PUBLIC WORKS & WATER RESOURCES DEPARTMENT  
NEW CASTLE COUNTY, DELAWARE

CORRUGATED METAL PIPE (CMP) LINING - 2018

CONTRACT NO. 18-04


DRAWING INDEX		
DRAWING NO.	SHEET NO.	SHEET TITLE
1	1 OF 7	TITLE SHEET
2	2 OF 7	KEY SHEET AND NOTES
3	3 OF 7	AREA 1 – OLD PAPER MILL ROAD
4	4 OF 7	AREA 2 – CREEK BEND DRIVE
5	5 OF 7	AREA 3 – WYOMING ROAD
6	6 OF 7	AREA 4 – DEVON DRIVE
7	7 OF 7	AREA 5 – BELLEVUE ROAD

PROJECT  
LOCATIONS



NOT TO SCALE

ISSUED FOR BIDDING




MISS UTILITY  
OF  
DELMARVA

BEFORE YOU DIG CALL  
1-800-282-8555 (in Del.)  
1-800-441-8355 (Md., Va.)  
PROTECT YOURSELF, GIVE TWO  
WORKING DAYS NOTICE


REV.	DESCRIPTION	DRAWN	DATE
1	ISSUED FOR BIDDING	AJB	5-22-18
2	—	—	—
3	—	—	—
4	—	—	—
5	—	—	—
6	—	—	—

PREPARED FOR:




220 SOUTH MAIN STREET  
302-366-7000

ENGINEER SEAL

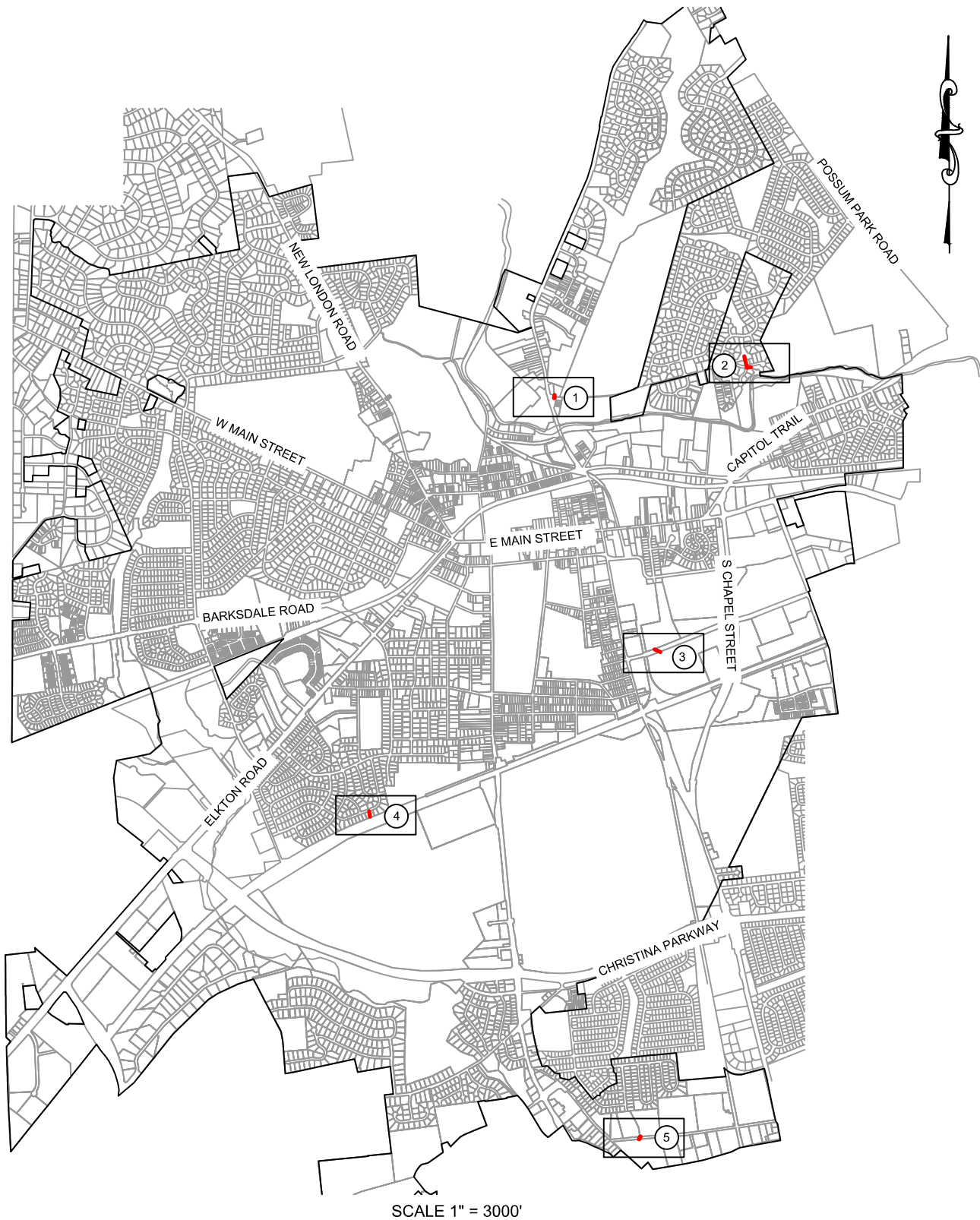


PREPARED BY:



121 Continental Drive, Suite 300 Newark, DE 19713

SHEET NO.	1 OF 7
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GENERAL NOTES

1. DRAWINGS HAVE BEEN CREATED FROM THE FIRST MAP GEOSPATIAL DATA EXCHANGE, GIS INFORMATION, AND STORM WATER PLANS. ADDITIONAL BURIED UTILITIES OR STRUCTURES MAY BE ENCOUNTERED. NO EXCAVATIONS WERE CONDUCTED DURING THE PREPARATION OF THESE PLANS. THE CONTRACTOR SHALL VERIFY ALL INFORMATION TO HIS OWN SATISFACTION. EXACT LOCATION AND COMPLETENESS IS NOT GUARANTEED. CONTRACTOR SHALL BE AWARE THAT A MISS UTILITY TICKET WAS NOT SUBMITTED FOR THE PREPARATION OF THESE PLANS. THE CONTRACTOR IS RESPONSIBLE FOR VERIFYING ALL INFORMATION THAT MAY AFFECT WORK.
2. THE CONTRACTOR SHALL BE FULLY RESPONSIBLE FOR ANY AND ALL DAMAGES WHICH HAVE OCCURRED BY HIS/HER FAILURE NOT TO EXACTLY LOCATE AND PRESERVE ANY AND ALL EXISTING UTILITIES, STRUCTURES, AND OTHER FEATURES AFFECTING HIS/HER WORK. ITEMS SHALL BE REPLACED WITH THE SAME TYPE OF MATERIAL THAT WAS REMOVED OR DAMAGED DURING CONSTRUCTION OR AS DIRECTED BY THE ENGINEER.
3. THE CONTRACTOR IS RESPONSIBLE FOR COORDINATING THE LOCATION AND ACTIVITIES OF HIS FORCES WITH THE OWNER, AND ABUTTING PROPERTY OWNERS TO MINIMIZE INTERFERENCE WITH EXISTING UTILITIES, PEDESTRIAN TRAFFIC, AND PROPERTY ACCESS. PEDESTRIAN AND VEHICLE ACCESS SHALL BE MAINTAINED AT ALL TIMES. THE CONTRACTOR IS RESPONSIBLE FOR CONTACTING THE CITY OF NEWARK, DEPARTMENT OF PUBLIC WORKS AND WATER RESOURCES PROJECT MANAGER ETHAN ROBINSON AT 302-366-7000, 48-HOURS PRIOR TO THE START OF CONSTRUCTION.
4. CONTRACTOR SHALL TAKE ALL NECESSARY PRECAUTIONS TO PROTECT ALL EXISTING UTILITIES, CURBS, SIDEWALK, PAVING, SHRUBS, FENCING, ETC, AND MINIMIZE DISTURBANCES TO PRIVATE PROPERTY. ANY AND ALL DAMAGE DONE TO SAME SHALL BE IMMEDIATELY AND COMPLETELY REPAIRED AT CONTRACTORS EXPENSE.
5. METHODS, PROCEDURES, AND THE SEQUENCE OF CONSTRUCTION ARE THE RESPONSIBILITY OF THE CONTRACTOR.
6. ROADWAYS SHALL BE KEPT CLEAN AT ALL TIMES. ALL MATERIALS SPILLED, DROPPED, WASHED, OR TRACKED ONTO ROADWAYS OR OTHER IMPERVIOUS SURFACES MUST BE REMOVED IMMEDIATELY.
7. ALL WORK SHALL BE CONDUCTED IN THE PUBLIC RIGHT OF WAY. THE CONTRACTOR IS RESPONSIBLE FOR OBTAINING ALL TEMPORARY CONSTRUCTION EASEMENTS TO PERFORM WORK OUTSIDE THE PUBLIC RIGHT OF WAY.

LEGEND

- JUNCTION BOX
- DISCHARGE POINT
- INLET
- MANHOLE
- LINING SEGMENT
- GRAVITY MAIN
- CULVERT
- AREA NUMBER

MAINTENANCE OF STREAM FLOW AND EROSION AND SEDIMENT CONTROL NOTES

1. THE CONTRACTOR SHALL BE RESPONSIBLE FOR ADHERING TO THE CONSTRUCTION SITE POLLUTION PREVENTION SPECIFICATIONS AS DETAILED IN SECTION 3.6 OF THE "DELAWARE EROSION AND SEDIMENT CONTROL HANDBOOK". ALL COSTS ASSOCIATED WITH ADHERING TO THE STANDARDS SHALL BE INCIDENTAL TO THE PROJECT SITE CONSTRUCTION COSTS.
2. EROSION AND SEDIMENT CONTROL AND STREAM DIVERSION DEVICES SHALL BE PLACED AS NECESSARY IN ACCORDANCE WITH THE DELAWARE SEDIMENT AND CONTROL HANDBOOK FOR CONSTRUCTION SITE ACCESS, MATERIAL STORAGE, TEMPORARY LAY DOWN AREAS AND DISTURBED AREAS ON SITE. PAYMENT SHALL BE INCIDENTAL TO THE PROJECT SITE CONSTRUCTION COSTS. THE FOLLOWING ITEMS MAY BE REQUIRED (BUT NOT LIMITED TO) BASED ON INDIVIDUAL SITE IMPACTS:
  - A. 3.1.7 COMPOST FILTER LOG
  - B. 3.2.1.2 GEOTEXTILE DEWATERING BAG
  - C. 3.3.11 RIPRAP STILLING BASIN
  - D. 3.5.2 STREAM DIVERSION
  - E. 3.5.2.2 COFFERDAM STREAM DIVERSION (SAND BAG DIKE)
3. THE FOLLOWING STREAM DIVERSION PROCEDURES SHALL BE FOLLOWED BASED ON EXISTING SITE CONDITIONS:
  - TYPE I – STREAM CROSSINGS WITH MULTIPLE CULVERT CELLS. THIS WILL CONSIST OF A CLEAN WATER DIVERSION INTO A SINGLE OR MULTIPLE BARREL CULVERT, WHILE WORK IS BEING PERFORMED ON THE SITE. THE DIVERSION WILL BE ACCOMPLISHED USING THE STANDARD SAND BAG COFFERDAM DIVERSION TECHNIQUE OR OTHER INNOVATIVE SOLUTIONS AS FEASIBLE BASED ON CHANNEL FLOW CHARACTERISTICS. TEMPORARY STABILIZATION WILL BE PLACED ON THE DOWNSTREAM DISCHARGE OF THE STREAM DIVERSION AS NEEDED. DEWATERING WITHIN THE WORKSITE SHALL BE DONE USING A GEOTEXTILE DEWATERING BAG PLACED IN A STABILIZED LOCATION DOWNSTREAM OF THE CULVERT IN ACCORDANCE WITH THE LATEST DNREC STANDARD SPECIFICATIONS. THIS SUMP PIT WILL DISCHARGE THROUGH A DEWATERING BAG, TO A STABILIZED OUTFALL ALONG THE BANK. THE TYPE I STREAM DIVERSION WILL BE SHIFTED TO THE IN-PLACE BARRELS AS WORK PROGRESSES. THIS SHIFT IS EXPECTED TO BE DONE ONCE AT EACH DESIGNATED LOCATION. THE WORKSITE BEING DEWATERED SHALL REMAIN FREE OF MATERIALS, EQUIPMENT, AND DEBRIS AT THE END OF EACH WORK DAY.
  - TYPE II – WILL INCLUDE A PUMPING OPERATION TO DIVERT THE STREAM. IT IS EXPECTED THAT THE TYPE II OPERATION WILL BE DONE AT THE LOCATIONS WITH A SINGLE BARREL CULVERT. A SANDBAG DIKE (SBD) WILL BE PLACED AT BOTH THE UPSTREAM AND DOWNSTREAM ENDS OF THE CULVERT. THE UPSTREAM SBD WILL BE PLACED TO MANAGE THE BASE FLOW OF THE STREAM. THE DOWNSTREAM SBD WILL BE PLACED SUCH THAT THE TOP ELEVATION IS BELOW THE LOWEST ELEVATION OF THE UPSTREAM SBD. A RIPRAP STILLING BASIN WILL BE USED AT THE UPSTREAM SIDE OF THE CULVERT DISCHARGING TO A STABILIZED OUTFALL ON THE DOWNSTREAM END SHOULD THE PUMPING OPERATION TAKE MORE THAN TWO (2) DAYS. A PUMP WITH A FLOATING INTAKE MAY BE USED AT THE UPSTREAM SIDE DISCHARGING TO A GEOTEXTILE DEWATERING BAG PLACED AT A STABILIZED OUTFALL DOWNSTREAM FOR PUMPING OPERATIONS LESS THAN TWO (2) DAYS. DEWATERING WITHIN THE WORKSITE SHALL BE DONE USING A GEOTEXTILE DEWATERING BAG PLACED IN A STABILIZED LOCATION DOWNSTREAM OF THE CULVERT IN ACCORDANCE WITH THE LATEST DNREC STANDARD SPECIFICATIONS. THE WORKSITE BEING DEWATERED SHALL REMAIN FREE OF MATERIALS, EQUIPMENT, AND DEBRIS AT THE END OF EACH WORK DAY.
  - TYPE III – WILL INCLUDE SPECIAL OPERATIONS FOR SITES THAT ARE NOT WITHIN A STATE MAPPED STREAM OR WATERWAY. THIS INCLUDES THE ROADWAY STORM SEWER CONDUIT AND STORMWATER MANAGEMENT BMP OUTFALL CULVERTS. THE CONTRACTOR SHALL PROVIDE THE NECESSARY MATERIALS TO TEMPORARILY STOP OR BYPASS FLOWS AS NEEDED. CARE SHALL BE TAKEN TO AVOID DAMAGING EXISTING INLETS, OUTLET STRUCTURES, AND PIPES. TEMPORARY BYPASS MEASURES SHALL NOT IMPEDE FLOW OR RESULT IN FLOODING OF THE UPSTREAM NETWORK OR STORMWATER MANAGEMENT BMPs.

ISSUED FOR BIDDING

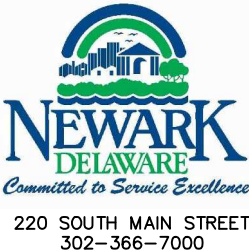


MISS UTILITY  
OF  
DELMARVA

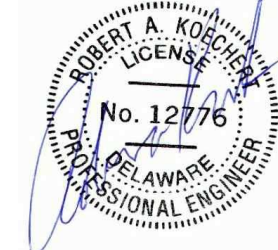
BEFORE YOU DIG CALL  
1-800-282-8555 (in Del.)  
1-800-441-8355 (Md., Va.)  
PROTECT YOURSELF, GIVE TWO  
WORKING DAYS NOTICE

REV.	DESCRIPTION	DRAWN	DATE
	ISSUED FOR BIDDING	AJB	5-22-18
	—	—	—
	—	—	—
	—	—	—
	—	—	—
	—	—	—

PREPARED FOR:



ENGINEER SEAL

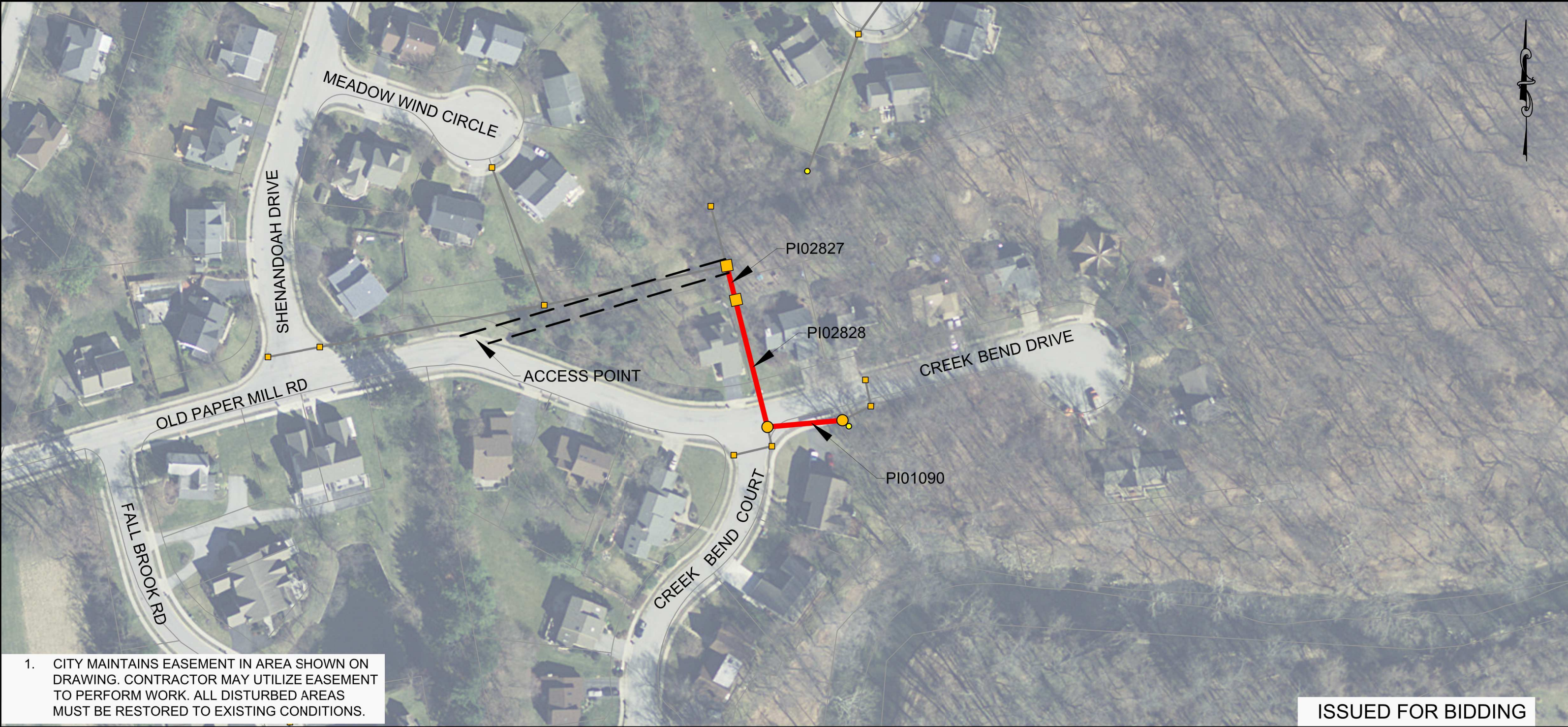


PREPARED BY:



SHEET NO. 2 OF 7





1. CITY MAINTAINS EASEMENT IN AREA SHOWN ON DRAWING. CONTRACTOR MAY UTILIZE EASEMENT TO PERFORM WORK. ALL DISTURBED AREAS MUST BE RESTORED TO EXISTING CONDITIONS.

ISSUED FOR BIDDING

CORRUGATED METAL PIPE (CMP) LINING - 2018

ASSET ID	DIA.	LF	DESCRIPTION	ASSET ID	DIA.	LF	DESCRIPTION
PI02827	48"	37	48-INCH CMP TO BE LINED	PI02828	48"	138	48-INCH TO BE LINED
PI01090	48"	79	48-INCH CMP TO BE LINED	-	-	-	-

●

JUNCTION BOX

●

DISCHARGE POINT

■

INLET

●

MANHOLE

—

LINING SEGMENT

—

GRAVITY MAIN

—

CULVERT

REV.

①

②

③

④

⑤

⑥

DESCRIPTION

ISSUED FOR BIDDING

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DRAWN

DATE

AJB

5-22-18

ENGINEER SEAL

1 in = 100 ft

CONTRACT

18-04

AREA

2-CREEK BEND DRIVE

SHEET NO.

4 OF 7



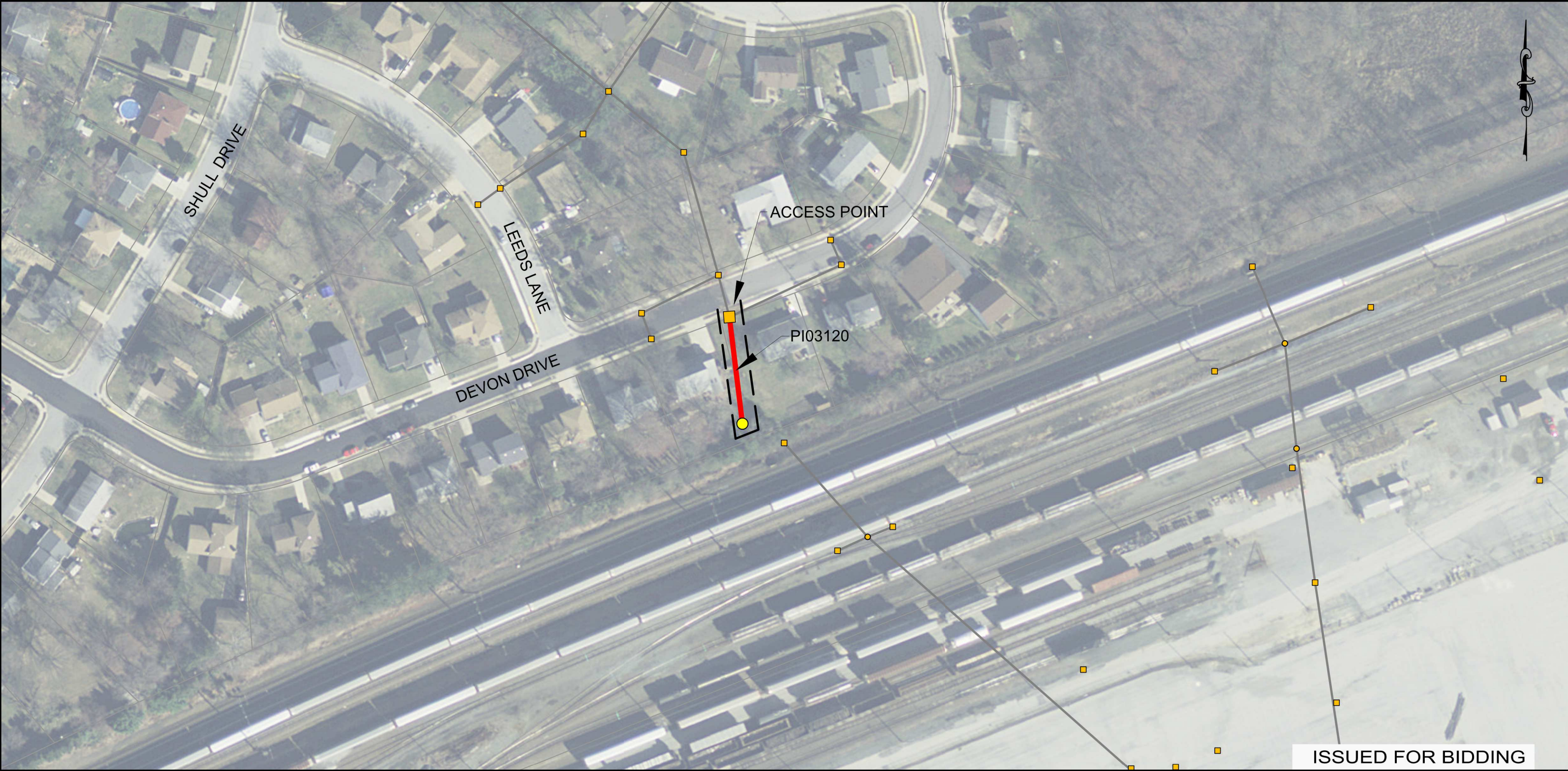
1. WYOMING ROAD IS OWNED AND OPERATED BY DELDOT. CONTRACTOR IS RESPONSIBLE FOR COMPLYING WITH ALL DELDOT MAINTENANCE OF TRAFFIC REQUIREMENTS.

ISSUED FOR BIDDING

CORRUGATED METAL PIPE (CMP) LINING - 2018

ASSET ID	DIA.	LF	DESCRIPTION	ASSET ID	DIA.	LF	DESCRIPTION
CL00110	64"x43"	131	64"x43" ARCH CMP TO BE LINED	-	-	-	-

<div>Legend</div> <ul style="list-style-type: none"><li>JUNCTION BOX</li><li>DISCHARGE POINT</li><li>INLET</li><li>MANHOLE</li><li>LINING SEGMENT</li><li>GRAVITY MAIN</li><li>CULVERT</li></ul>	REV.	DESCRIPTION	DRAWN	DATE	<div>ENGINEER SEAL</div> <div>ROBERT A. KOECHER LICENSE No. 12776 DELAWARE PROFESSIONAL ENGINEER</div>	<div>1 in = 100 ft</div> <div>NEWARK DELAWARE</div> <div>JMT</div>	
	①	ISSUED FOR BIDDING	AJB	5-22-18			
	②	—	—	—		CONTRACT	18-04
	③	—	—	—		AREA	3-WYOMING ROAD
	④	—	—	—		SHEET NO.	5 OF 7
	⑤	—	—	—			



CORRUGATED METAL PIPE (CMP) LINING - 2018

ASSET ID	DIA.	LF	DESCRIPTION	ASSET ID	DIA.	LF	DESCRIPTION
PI03120	48"	114	48-INCH CMP TO BE LINED	-	-	-	-

●

JUNCTION BOX

●

DISCHARGE POINT

■

INLET

●

MANHOLE

—

LINING SEGMENT

—

GRAVITY MAIN

—

CULVERT

REV.

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DESCRIPTION

ISSUED FOR BIDDING

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DRAWN

DATE

AJB

5-22-18

ENGINEER SEAL



1 in = 100 ft

CONTRACT18-04

AREA4-DEVON DRIVE

SHEET NO.6 OF 7



ISSUED FOR BIDDING

CORRUGATED METAL PIPE (CMP) LINING - 2018

ASSET ID	DIA.	LF	DESCRIPTION	ASSET ID	DIA.	LF	DESCRIPTION
CL00092	83"x57"	61	83"x57" ARCH CMP TO BE LINED	CL00093	83"x57"	60	83"x57" ARCH CMP TO BE LINED

<b>Legend</b> <ul style="list-style-type: none"><li>JUNCTION BOX</li><li>DISCHARGE POINT</li><li>INLET</li><li>MANHOLE</li><li>LINING SEGMENT</li><li>GRAVITY MAIN</li><li>CULVERT</li></ul>	REV.	DESCRIPTION	DRAWN	DATE	<b>ENGINEER SEAL</b> 	  1 in = 100 ft	
	①	ISSUED FOR BIDDING	AJB	5-22-18			
	②	—	—	—		CONTRACT	18-04
	③	—	—	—		AREA	5-BELLEVUE ROAD
	④	—	—	—		SHEET NO.	7 OF 7
	⑤	—	—	—			